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ALEXANDER VON HUMBOLDT.*

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PROPERLY to appreciate ALEXANDER VON HUMBOLDT's life-work, one must form a conception of the intellectual atmosphere from which he issued. The opinion may not unfrequently be found among laymen that there was no real German naturalist before Humboldt. They are accustomed, as if to a Hercules, to ascribe all deeds to him. It is not necessary to say that this is all a mistake; but even professional naturalists frequently remember too little of our older history. I do not speak of the almost ancient figures of Copernicus, Kepler, and Otto von Guericke; nor of Leibnitz, who had as clear a comprehension of the fundamental ideas of nature as we; but the eighteenth century displays names worthy of the highest degree of respect, almost as brilliant as these.

The Bernoullis developed analytic mechanics, Euler recognized the feasibility of achromatic glasses, Tobias Mayer reformed the theory of the moon, Lambert laid the foundation of photometry, Kant conceived the nebular hypothesis, and William Herschel, whom we count among our own, enlarged our knowledge of the starry heavens almost as if the telescope had just been discovered. Had the Dutch physicists left him time, the Canon of Camin would have certainly possessed a perfect

* From a memorial address delivered in the hall of the university, August 3, 1883. The speaker began his address by referring to the custom of annually celebrating the foundation of the university and the memory of its founder, King Frederick William III of Prussia; he then related the history of the efforts to raise funds to erect the statues of the brothers William and Alexander von Humboldt, just placed in the grounds of the university. Following this account with a brief comparative estimate of the talents of the two brothers, he continued, speaking more especially of Alexander.

title to have the Leyden-jar called by his name. Volta's electrophore is really Wilcke's discovery. Segner's water-wheel, Leidenfrost's and Sulzer's experiments, became the germs of important discoveries and applications. Stahl's phlogiston, even if it was a false conception, and Haller's *elementa*, in the long run, made chemistry and physiology German sciences. Herr Hofman has very lately taught us how to appreciate Marggraf's services in technical chemistry. Vater and Lieberkühn are still mentioned in the finer anatomy, and the first part of Sömmering's classical activity belongs to the same category. Caspar Frederick Wolf reformed the development-history and outlined the doctrine of the metamorphosis of plants. As early as 1785 Blumenbach, the founder of physical anthropology, led a class in comparative anatomy. In natural history, Rösel earnestly advanced the labors of Swammerdam and Réaumur; Ledermüller described the creatures which he called *infusoriæ*. Gleditsch performed the experimental demonstration of the sexuality of the phanerogams by fertilizing the palms in our botanical gardens with pollen from Leipsic. Even in classification, in which the rivalry of the seafaring nations with the Germans was so arduous, a few, like the creator of our fish-collection, Bloch, won imperishable fame. Germans also approved themselves as scientific travelers: the two Forsters, Cook's companions around the world; and in connection with the Russian expedition for observing the second transit of Venus, our Pallas, as a student of the Siberian fauna. Finally, in geognosy had Werner secured the uncontested leadership for the Germans as the pre-eminently mining people, among whom Agricola had previously created mineralogy.

This enumeration, which might be considerably extended, shows what good progress German natural science had made in the last century. Indeed, it is doubtful whether any other people can boast of a greater richness of notable achievements during the same period. But, toward the end of the century, the aspect was changed, to our disadvantage, and not without our fault.

After its early bloom in the middle ages, and the activity of the Reformation, the German mind, disturbed in its development by the Thirty Years' War, remained, as respects literary production, in the background. At most, it trifled a little in a tasteless way. Then, all at once, in the second half of the century, it rose to so mighty a flight that it not only recovered its lost rank, but placed itself, in some kinds of poetic creation, at the head of modern mankind. A constellation of talent arose, the like of which the ages of Augustus and Louis XIV did not see, nor the fifteenth century, except in other fields. Who can describe the intoxication of the nation, when immortal songs announced that the king's son had come whose kiss was to awaken the thorn-rose of German poetry out of its half a thousand years' slumber? At the same time there pressed upon us the new naturalism and emotionalism from England, and enlighten-

ment and gushing philanthropy from France. German society now acquired a strong literary interest. But while that part of the educated world which was susceptible to the more tender emotions led an æsthetic dream-life, the stronger minds were chained to the contemplation of the antique, or were sunk in the profundities of the simultaneously ripened critical philosophy. Thus the thought of the nation was far removed from realities, and directed toward beautiful fancies and ideal truths. If this had had the result of only diverting some from research and observation, the loss might have been borne. But, with the thoroughness with which the German does everything, the damage went deeper. The distinctions between æsthetic and scientific demands were effaced from the universal comprehension. The intuitions of art usurped the place of induction and deduction. Even the critique of the reason, just achieved by Kant, was pushed aside as narrow-minded scholasticism. An arrogant speculation believed its synthetic judgments *a priori* had grown so strong that it could undertake to construct the world from a few delusive formulas, and it looked down with extreme insolence upon the unpretentious daily work of the empiric. In short, the day came of that false philosophy which redounded to the shame of German science for a quarter of a century, whose advocates threatened our own generation, and which the best heads, elevating vague fancy and taste above the practical, were least able to resist.

The recollection of this perversion of the German mind is the more mortifying because it occurred simultaneously with the brightest phases of science outside of Germany, especially in France. While under the first republic and the first empire the muses were hushed to silence, there was gathered in Paris a circle of learned men of whom not only has each one left a bright trace behind him, but also in which as a whole lived the comprehension of the true method to which the Academy of Sciences has always persistently adhered. Coulomb and Lavoisier, Laplace and Cuvier, Biot and Arago, were partly the forerunners, partly the *coryphées* of that great epoch from which is dated the leadership which, during the first half of this century, made Paris the scientific capital.

The period of this momentous transformation in Germany, when æsthetic contemplation of the world and overweening speculation were mutually crowning each other and pushing intelligent experiment, like Cinderella, into a corner—this period was that of Alexander von Humboldt's youth. A remarkable youth he must have been, exuberant of thought, and yet burning with the thirst for action; eloquent and enthusiastic like a poet, and yet devoted with all his mind to the study of Nature; in knowledge already a reflection of the Cosmos, and yet indefatigable in accurate examination and experiment; a born master of the German speech, yet at home in every idiom; in such guise he appeared in the intellectual center of the Germany of the day, in Jena,

younger than Goethe by twenty, than Schiller by ten years, and yet welcomed by both as if he were their peer in age.

He figured as the friend of Willdenow, Georg Forster, and Leopold von Buch, as the pupil of Blumenbach, Lichtenberg, and Werner, already known by minor writings in which his industrious manysidedness had early displayed itself, already a much-traveled man according to the ideas of the day, and, although of independent means, a servant of the state, on the way to the highest honors. In what was he not interested, and what did he not take up? Ancient weaving, subterranean flora, basalt, meteorological phenomena, the theory of logarithms, had engaged him; but, when it was worth while, he knew how to concentrate his strength upon a single point. Galvani's discovery had recently stirred naturalists and physicians to effort. "In the fall of 1792, having become acquainted with it in Vienna, Humboldt, traversing Germany in every direction as a miner, physicist, and botanist, 'wandering upon desolate and remote mountains where he was sometimes cut off from all literary intercourse,' already revolving the plan of his tropical journey in his head, had still found time to make thousands of most delicate experiments. Even on horseback, besides hammer, glass, and compass, he was never without 'his galvanic apparatus, a pair of metal rods, pincers, a glass stand and an anatomical knife,' and the curse which the Bolognan anatomist had invoked upon the poor race of batrachians overtook them under Humboldt's hand, even in places in which they had previously been secure from it." Now he had talked with Alessandro Volta, in his villa on the Lake of Como, of the crucial experiment in animal electricity, Galvani's convulsion without metals, and was preparing to collect the results of his investigations in the book on "Excited Muscular and Nervous Fibers." He must confirm his own researches with experiments on frogs' legs, and he opportunely called not only his brother, but also "Herr von Goethe," to be his witnesses.

Among the various individualities which were united in him into a complicated whole, and which we meet in analyzing this being, is first of all an artist. The "Rhodian Genius," the "Views of Nature," the address at the opening of the assembly of naturalists, are art-works. That work of Humboldt's which, like Goethe's "Faust," contemplated from youth, was completed with an astonishing energy only in an advanced old age, may certainly claim to be an artist's production. We shall for the present leave unanswered the question of the utility of this kind of mingling of the poetic element with the scientific, in which we may recognize a return to the models of Plato and Lucretius. Aside from his native propensity, Humboldt was led toward it by the æsthetic manner of thinking then prevailing in Germany, which had become a second nature to him, and especially by his intercourse with our great poets. It must not, however, be forgotten that something of the same kind had been observed a little while before in France. Buffon's

"Epoques de la Nature," his sketches, flowing in splendid word-waves, of men and animals, Bernardin de Saint-Pierre's magnificent pictures of tropical nature, were well fitted to spur Humboldt's literary ambition in emulation of them. If his style has lately been criticised, that shows that he had a style. Indulgence in the creation of beautiful forms of language was agreeable to the taste of his age; and why should I not tell how he, presuming upon a similar receptivity in myself, read to me from the proof-sheets of his "Cosmos" passages which particularly pleased him, such as the one in which he ingeniously summarizes all that the moon is to our earth; enlivening the firmament by its changes, comforting the heart with its mild luster, and in geological periods carving out continents through the erosive work of the tides?

More subject to criticism is the other influence which the dominating mind of Humboldt exercised over Germany in his ninetieth year. At nothing are laymen more surprised than when they hear that Humboldt did not stand on the extreme height as a naturalist, but that his situation in a mental respect was like that he found himself in on Chimborazo, when an impassable chasm separated him from the summit. The gap which opened between him and the topmost peak of natural science was the want of physico-mathematical knowledge. Not that this was denied his talents. He had in his youth an inclination to pure mathematical research. But the taste, and later also the mental habit, of analyzing phenomena within a certain scope and tracing them to their ultimate recognizable principles, deserted him. He became satisfied with establishing and examining facts. The mere telling, even at large, of those things that occupied his vision, and which he comprehended to the most minute details, or could deduce at every instant, was tiresome to him. It was, indeed, the cosmos; only there is, in that highest sense, no scientific comprehension of the cosmos. Mathematical physics knows of no difference between cosmos and chaos. By blind natural necessity, by the central forces of atoms independent of time, or by some other equivalent hypothesis of the constitution of matter, it concedes that cosmos may have come out of chaos. The cosmos, the beautiful and harmonious aggregate of nature, is an æsthetic anthropomorphism. Humboldt explained the title "Cosmos" with the phrase, "Sketch of a physical description of the universe." According to Herr Gustav Kirchhoff's definition of mechanics, one might easily place these words upon Newton's "Principia" or Laplace's "Mécanique céleste." But, by description, Humboldt understood only a graphic, not a mechanical description, and there is the same difference between his description of the world and that of Newton or Laplace as between the description of a plant and the calculation of a disturbance. In that he adhered to his conception through his whole life, and attached the highest value to it, he showed himself a genuine child of a stage of discipline more fitted for artistic methods of view than for scientific analysis.

While German science was involved in the enervating network of æsthetic speculations, his own energy and happy skill enlisted Humboldt in wider spheres of healthy activity for its salvation. Even in our fast-living age, it is hard to conceive that only two years after he had been enjoying in the Saal Valley those visions, short indeed, but in a certain sense, like a young love, decisive as to his life, he was observing in Cumana the first periodical shower of stars, and discovering the electric folds in the brain of the torpedo-eel; was exploring the caves of Caripe resonant with the cries of the *guachero;* was threading in a pirogue, environed with alligators, the stream-net of the Rio Negro and the Cassiquiare between the Orinoco and the Amazon; and in Esmeralda, on the upper Orinoco, was observing the concoction by the natives of the weird arrow-poison, curare, which owes its name to him. Nothing was wanting to raise the fantastic charm of these journeys, from which, nevertheless, Humboldt brought back a greater sum of acute, distinct observations in every conceivable field of science, in geography and anthropology, than any single observer ever collected either before him or after him. No! The world will "never see his like" in comprehensive, restless activity, combined with lofty thought; in dauntless venture for ideas, with the wisest saving of means and strength; in soaring height of feeling, the expression of which frequently, in view of the sad contentions of mankind or of the horrors of slavery, for instance, has an elegiac tone, as in a similar way a delicate haze adorns his sketches of the giant heights of the Cordilleras.

It is essential to the success of a scientific journey, first of all, that the traveler return. But, besides threatening him with physical dangers, which Humboldt's apparently not very strong body resisted wonderfully, long journeys in wild regions have other inconvenient consequences. Habituation to perfect freedom in solitude, to constant change and external stimulation, even excitement, the diversion from accustomed literary occupations, render it very hard for travelers to feel themselves at home again, to give themselves up to the complicated demands of cultivated society, and to be satisfied to make the most of the treasures they have brought with them. They seem to prefer to such allegiance a return to the wilderness, so that it is said of African travelers that the greatest danger that threatens them is the unconquerable propensity, when they have once escaped the perils of the journey, to try them again. Thus it was with Humboldt's fellow-traveler, Bonpland, who was drawn back to South America, where it was his fate, not to perish, but to be lost to science, a prisoner to Dr. Francia. He left to Humboldt, in whom no trace of such weakness could be found, the fruit of many of their common labors.

Humboldt had lived in Paris before his journey. He now permanently fixed his place of labor there, as the only place where he could perfect the literary undertakings he had planned; and as with curious

facility he had become a Spaniard in New Spain, so, without denying his German, he made the Parisian academicians forget that he was not a Frenchman. In this, that gift of ready wit with which, while a student at Frankfort, he had troubled the more serious William, and which he used as a powerful weapon in his subsequent court-life, was of much advantage to him. Associated with Gay-Lussac and Provençal in labors which are still instructive, he was received into that small circle of learned men that gathered around the venerable Berthollet at Arcueil. All of these and numerous other friendships of Humboldt's are thrown into the shade by the life-long connection he formed with Arago, to which the contrast of their natures lent a peculiar charm.

Humboldt was at first sight of insignificant, flattering, and pliant appearance, Arago of imposing bearing, a type of fiery Southern manhood; Humboldt of encyclopedic mind and knowledge, Arago an astronomer and mathematico-physicist of so sharply limited a scope and so strict a school that, while he analyzed according to three axes the modifying effects which neighboring masses of metals exercise upon magnetic deflections, he left it to Faraday, who could not square a binomial, to find out their causes. Like Humboldt, Arago was a master of comprehensive scientific description; but, while Humboldt inclined to melting pathos, the dazzling polish of Arago's keen language becomes a tiresome mannerism. Sympathy in political views was a bond between them. Arago was a republican, Humboldt called himself a democrat of 1789. Probably this was the reason of the contemptuous condescension with which Napoleon I, among whose faults was not want of respect for science, used to meet him.

In connection with Arago, Humboldt, as he was fond of telling, ruled for twenty years what was then the first scientific body in the world. If not of his fame, this period was the climax of his life. As in the primitive forest he had watched through nights undisturbed by the murmur of the cataracts, the humming of the mosquitoes, the near roaring of the jaguars, and the fearful cry of the beasts in the tree-tops above him, so now were the confusing pressure of the world's metropolis, the thousand personal demands daily thrust upon him, the brilliant society of the *salon*, the intrigues of academical lobbies, to him only a pleasant, stimulating life-element. He found gratification in this mental tumult, which, busy with the air and matter of life, overlooked him while he built up the gigantic coral structure of the many-membered story of his travels. More and more consumed with an inextinguishable enthusiasm for science; in unlimited devotion to knowledge, neglecting domestic fortune; drawing into the line of his activity hosts of learned men and artists, and skillfully utilizing their talents for his own objects; not, indeed, teaching *ex cathedra*, but inspiring youth by his example and continually encouraging them—he was at that time in Paris, as afterward in Berlin, a central figure, from

which force radiated on every side, and in which numerous threads ran together.

That was the time when he, sometimes with an essay only a few pages long, created new studies, like that of plant-geography; or by some suggestive medium of graphic representation, such as the isothermal curves, revealed the law hidden in formless masses of single facts. As the whole real world waved before his inner vision, so "swelled before him also the historical flood of floods," only that he festooned the bare scaffold of civic history with the fruit and flower garlands of the history of civilization, of discovery, and of art. As Uhland composed some of his finest romances in Paris, there likewise originated the "Views of Nature," Humboldt's favorite work.

While the reminiscences of Jena were thus revived in him, his mind was nevertheless permanently purified from much dross that had clouded it in those days. In the interval that separates Humboldt's labors after the journey to the tropics from the "Experiments on Excited Muscular and Nervous Fibers," we recognize the influence of his intercourse with the Parisian academicians, of their always careful, frequently exaggeratedly skeptical views. In one point, excelling through the greater depth of German thought, he left his masters behind him. While a kind of shallow vitalism was prevailing in France, Humboldt had long passed the position he had once sustained in the "Rhodian Genius," and had explained the process of life as a result of the physical and chemical qualities of the matters combined in the organic texture.

It is perhaps less known that Humboldt was a pre-Darwinian Darwinian. He gave me the "Essay on Classification," sent him by Louis Agassiz, in which, only three years before the appearance of the "Origin of Species," a book Humboldt did not live to see, the doctrine of periods of creation and teleological views were portrayed with unblunted sharpness, and supported by numerous plausible arguments. Humboldt's expressions on this occasion left me no doubt that he, far from sympathizing with Agassiz's views, was a believer in mechanical causation, and an evolutionist. If we may credit certain Parisian traditions, Humboldt and Cuvier were not on the best footing with each other. Perhaps Humboldt was more inclined toward the doctrines of Lamarck and Geoffroy Saint-Hilaire.

It is time to consider what had become of German science during this period. It had, in a certain sense, sunk deeper and deeper. Philosophical speculation had won ground at nearly all points, and in nearly all the universities its subtilties were announced as ready wisdom by professional philosophers as well as by naturalists and doctors, and were eagerly taken up by the misguided youth. Goethe's false theories and maxims, supported by his fame as a poet, increased the confusion. The wars of Napoleon did harm to German science, not only by external force, but also through the Christian-romantic reaction

against the Hellenistic classicism of the preceding period that came in with the national rising.

Not that there were wanting voices to protest against the disorder, or men who knew better, but who disdained to engage in contention with persons talking like madmen. Germany could still boast of one of the first mathematicians and mathematico-physicists of all time. On his return, Humboldt had found the academy at Paris full of the fame of the youthful author of "Disquisitiones Arithmeticæ." Besides Humboldt, there were then in Paris to save the reputation of German science our Paul Erman, who received from the academy the prize in galvanism founded by Napoleon, and whose anatomy of the *Echinoderms* was also crowned by it, and pre-eminently Gauss. But even Gauss illustrates how small a place science and mathematics had in German ideas. Our pleasure in the dainty jest which Heinrich Heine, in his "Reisebildern," utters against the scientists of Göttingen, in the spcrtive parallel between Georgia Augusta and Bologna, is somewhat troubled when we remember that among those scientists was the immortal Gauss. Never on a similar occasion would a young French poet have overlooked the existence of Laplace.

Finally, the revolution approached. "The brilliant and brief saturnalia of a purely ideal natural science," as Humboldt mildly described it, was drawing toward an end. Natural philosophy had fulfilled none of its glittering promises; its draught, foaming and pungent at first, had grown stale. And just as, two generations before, a race of poets and thinkers had been produced all at once, so it happened, by a coincidence so remarkable that we guess a law in it, that there arose at this time a healthy and strong crop of genuine naturalists. There was, however, another element by which the external fortune of German science was henceforward materially affected. Frederick the Great had kept the eyes of the world turned toward the capital of his monarchy for half a century. By the calling of such men as Maupertius, Euler, and Lagrange, he had given the Academy of Sciences, recently founded by him, a temporary high luster, partly borrowed from abroad. A seat of German intellectual life, Berlin did not become, under him. The center of culture in Berlin lay in the French colony. If we abstract Lessing's brief residence, Moses Mendelssohn, the prototype of his Nathan, the correct, frigid Ramler, and the author of "The Joys of the Young Werther," Berlin had, in the last century, hardly attained any importance in German literature.

That since then Berlin, having become the political capital of Germany, has also pushed into the advance of the other German cities in an intellectual respect, was not the effect of a single cause, nor the work of any one man. Chief in the succession of circumstances that contributed to it was unquestionably the creation of the University of Berlin. The university could, indeed, not raise a new German Parnassus, even if the Berlin of that time had been the place for it; and

it could also only indirectly contribute to the blossoming of art. But it became, in the pursuit of its work from the first, the most important center of German knowledge as a whole. In reality the general enlightenment which had so often comforted the nation in its divisions, still remained spread over Germany to its salvation. In some points Berlin saw itself surpassed by small universities like that of Giessen. Between these and Berlin there was, however, always the difference that, while now and then some one or another small university would blaze up like a variable star to the first magnitude in some branch or another, to sink in a little while back into comparative obscurity, the sum of the aggregated mental forces in the Berlin University and Academy was the same, or rather increased, from the beginning.

Almost simultaneously with the blossoming of the university, in alliance with the national rising, and favored by the growth of the city and its prosperity, there had also been developed here a real German culture, and a perhaps not very productive but cleverly critical society had collected whose influence on German intellectual life was more perceptible because of the preponderance with which Berlin had come out of the war for freedom. As far as the habitual influence of so many older centers of learning and the independent spirit of the Germans, hostile to centralization, permitted, Berlin henceforth maintained the rank of intelligence appropriate to it as the capital of the state. That illustrious circle of writers, artists, and actively sympathizing women is now inconceivable without the background of the Berlin University; without Schleiermacher and Frederick Augustus Wolf, Savigny and Carl Ritter, Boeckh and Lachmann, Buttmann and Bopp, Hegel and Gauss; and in this sense we may say, that, through the foundation of the university, William von Humboldt elevated Berlin to be the intellectual capital of Germany.

While the University of Berlin fully represented science in nearly every direction, every mental phase of the nation was likewise reflected in it. Here was fought out in jurisprudence the battle between the historical and the philosophical schools; here was seen, in theology, dogmatic reaction to give way to rationalism. Here unrestrained speculation continued to have its way for a long time, natural philosophy blew its last party-colored bubbles, and Goethe's *Farbenlehre* was taught *ex cathedra*. Here it was, also, that that host of men arose who, in connection with many illustrious minds still adorning the Fatherland, repaired the faults of philosophical error, and gave to natural science an activity which was full of consequence for the world as well as for Prussia and Germany, and which still continues. Is it necessary to name them, when so many of them are looking down upon us from these walls—Eilhard Mitscherlich, Heinrich and Gustav Rose, Encke and Poggendorff, Weiss and Lichtenstein, Ehrenberg and Johannes Müller, Dove and Gustav Magnus, and besides them the mathematicians, Lejeune-Dirichlet and Steiner, and later still

Jacobi; and finally, yet remaining among us, the last of his race, Herr Peter Riess? It was a glorious time for German science, little as a precocious and spoiled youth is wont to esteem the men who, themselves almost without teachers, trained their teachers; a time to write whose connected history, the materials for which lie at hand in numerous memorial addresses, would be a thankful task and a patriotic duty; for it was the time when the German nationality, to which so much importance is now attached, grew strong in science also, to proud independence. But the crowning was reserved for the epoch in which Alexander von Humboldt exchanged his former residence in Paris for Berlin. The Italian double-entry book-keeping, which he had learned when young in the trade-school at Hamburg, enabled him, as he told me, to observe how his originally quite considerable means were wasting away in the sums which the publication of his travel-work consumed. When this occasion compelled him, in obedience to the wish of King Frederick William III, much against his inclination, to remove to Prussia, we can only see in this turn of fortune the fulfillment of his high calling, and in the epos of his "much-moved life" admire the remarkable concatenation by means of which, during Alexander's long absence, his brother William, by the foundation of the Berlin University, had prepared a suitable location for his continued activity.

It is hard in this all-leveling time to give an idea of the dominant position that spontaneously fell to him here. In consequence of the long depression of science in Germany and its contemporaneous bloom in France, Paris was endowed in the eyes of German naturalists with a luster of which the present generation knows nothing. We learned from French text-books, we worked with instruments made in Parisian shops, and a long residence in Paris was considered an indispensable finish to a good scientific education. We may conceive, from this consideration, what a halo would surround the head of a man who had played such a part in Paris as Humboldt had done. He returned home as a king comes back to his kingdom after a long campaign of conquest, and was received by the circle of Berlin naturalists, which had grown up in the mean time, as a prince is received by his magnates.

We can more easily represent to-day the favorable circumstances that assured to the brother of William von Humboldt his familiar place in the highest circles of society and his relations to the court. The Cosmos-lectures, the meeting of the German naturalists at Berlin in 1828, the journey into Central Asia, made under the commission of the Czar of Russia, pressed Alexander von Humboldt's figure before the German public far in advance of that of any other scientific man. His peculiar dependent-independent position between the court and ministry; the impregnable footing of scientific fame and unselfish exertion on which he stood; his profound knowledge of men and affairs, and his perfect tact; a power for work that was equal to numer-

ous visits, notes, and letters, as well as to days and nights of continuous observations of magnetic terms; and, finally, a grace in intercourse that disarmed all contradiction—all of these things together made him a real power; and how frequently did he use his power for the good of this university!

At that time, when the limited means of the state made it harder to raise a couple of hundred thalers for scientific purposes than as many thousand marks now, no emergency arose for which Humboldt did not obtain the needed means by his personal intercession; and as now the Academy of Sciences will on satisfactory assurances advance money to young men engaged in merely prospective scientific enterprises, so was Humboldt then the earthly providence of all students. What matter is it that his zeal was sometimes mistaken, and that among the number of those to whom he opened the way was now and then one who came short of fulfilling the hopes set upon him? Even academicians are not infallible in the choice of their *protégés*. If he had a preference for travelers, for his own specialty, did he not also let his sun shine on philologists as well as on naturalists? Who would examine as with a psychological lens the secret motives that impelled him to such touching sacrifices for things quite remote from him? Of course, Humboldt had the faults of his virtues. Ambition is the source of all greatness, but it is hard to draw the line that separates it from vanity. Humboldt used his sharp tongue and pen not only as weapons of defense, but he frequently gave them freer license than was perhaps good. But what signifies the dread that some felt of his criticisms, in the face of such testimony as that of August Boeckh, that he never came away from Humboldt's presence without feeling exalted and inspired with new love for all that is good and noble? There is one other example of a personality which, like Humboldt's, reached such power by pure intellectual force that peoples on both sides of the great sea waited for his words, and kings listened to him: this was Voltaire, in the eighteenth century. The two men, notwithstanding the deep-reaching differences between them, afford many points of resemblance. Both were born in a capital—Voltaire in Paris, Humboldt in Berlin; Voltaire reaching out of the "grand century" into a new period which he had helped to introduce; Humboldt from the classical period of our literature to a new scientific period that had been partly prepared for by him; in both a poet was paired with a naturalist, but the poet predominating in Voltaire, the naturalist in Humboldt; both disappearing from the scene for a period in youth, Voltaire to return after his study-travel to England, Humboldt from his tropical journey, with great acquisitions; Voltaire afterward in Berlin, Humboldt, at least in his later abode in Paris, living near the throne; both occasionally intrusted with diplomatic business; both animated to the noblest exertions, but not above a well-directed jest; both regarding mankind as their family, without a domestic hearth; Voltaire power-

fully grasping the tragic fate of Calas, Sirven, and De la Barre, Humboldt in happier times only summoning his force to obtain a salary for poor Eisenstein, or to prosecute Haupt's appeal; the fame of both suffering from the fact that their teachings and discoveries having long ago become common property, only a few know whom to thank for them; finally, both in extreme old age glowing "with that youth which never forsakes us," and active to the latest breath; Voltaire busy with his "Irène" and the "Dictionnaire de l'Académie," Humboldt with the "Cosmos." What the "Experiments on Excited Muscular and Nervous Fibers" was for the youth Humboldt, and the "Travels" and "Views of Nature" for the man, the "Cosmos" was for the old man. We have already questioned the fundamental thought of this famous book from the point of view of theoretical natural history, and of the doctrine of the persistence of force. We have frequently entertained the query whether such a mixture of styles as rules in it is correct or not. It certainly is not becoming to the naturalist. But it is clear that it is exactly this form of representation that makes possible the immense influence of the book, that has over the whole inhabited earth prompted hundreds of thousands to join in asking questions they had not thought of before; that, particularly in Germany, lifted the ban under which natural science had lain in the ideas of the cultivated, as if it were a domain from which common men were excluded, and were accessible only to a few particularly qualified to enter it, and about which one need not be concerned unless he have some special inclination or calling for it. It has been remarked that by *science* the French understand only natural science, by *Wissenschaft* the Germans only mental science. Goethe's scientific efforts, in consequence of their semi-æsthetic character, their desultoriness, and the bitter hostility he showed to all associated research, could not change the case. If it is now different, and the state recognizes the full importance of science, it is, of course, immediately the result of the technical triumphs science has achieved. But the turn for the better we ascribe originally to the Cosmos-lectures, which, for the first time in Germany, led a cultivated German audience to imagine that there was something else in the world than *belles-lettres* and music, than the "Morgenblatt" and Henrietta Sonntag. And although Humboldt himself, as we have already said, did not rise to the very apex of science, it was, nevertheless, this less exalted height at which he stopped that permitted him to make himself comprehensible to the ordinary children of men.

While, indeed, he was not as sublime as Newton or Laplace, while he did not mirror one side of the world in absolute perfection like Gauss, he was able to make an entrance among the multitude for the truths discovered by those archangels of science. While he shared with them the universal human feeling for the beautiful in sublime things, he was incited to project a "picture of Nature," at the risk that

it would not give back the measure of the depth, and that no frame could inclose the infinity of the object. Having once come out from Heyne's philological school, and still, when sixty years old, with the college portfolios under his arm, taking his place in our audience-rooms among Boeckh's students, he was the man to lay the bridge between the old and the new time, between the philological-historical, æsthetic-speculative Germany, as the turn of the century saw it, and the mathematico-scientific, technical, inductive Germany of our days.

The German people, indeed the world, has remembered his loving, enthusiastic devotion. Not the thousands of well-observed, important, and new facts with which he has enriched single branches; not the happy and suggestive thoughts thrown out as seed-corns and sometimes grown up to new sciences; still less his historical and geographical works composed with ceaseless industry—furnish the reasons why he sits out there in a marble image. The composition of the whole world into an artistically harmonious figure attempted by him, the combination of the ideal with the real realized in him, of the poet with the naturalist, made him, in Emerson's sense, a representative man of science, and educated manhood in that statue has set up Alexander von Humboldt as a personification of a new phase of its own genius, of which it became conscious through him.

The custom of honoring the memory of a great man by a monument would have little significance if the monument had no other purpose than to keep up that memory; for, if the remembrance would be lost without the monument, it would not be worth keeping up. The monument should rather, calling back to thought the hero who has gone out from among us, lead us, in reflecting on his virtues, to renew the determination to emulate them. We should ask ourselves how the man to whom we look up in grateful admiration would judge us if he should return to us, and whether he would recognize us as worthy prosecutors of the work he had begun.

Alexander von Humboldt died in a gloomy time. The reign of a king friendly to the muses, to whom he had personally stood closer than it is often allowed to a subject to stand, had fallen short of fulfilling expectations. The rule of Napoleon III, personally hateful to him, a friend of the house of Orleans, weighed upon France. A new and strong hand had taken the reins of Prussian state life; but it was sad to close his eyes at the instant when even to us a momentous decision seemed unavoidable.

With how deep satisfaction Humboldt would now see the imperial banners waving from the palace of the prince regent, and how the revolution in the fortune of the Fatherland, which we have witnessed since his death, would gratify him! But how deeply would it pain him to learn at what price the recovered power of the German Empire had to be bought!—that instead of the feeling of mutual esteem and friendship which during his life had bound Germany and France,

and to the confirmation of which he had contributed so much, had come in on the side of the French vengeful hatred and unappeasable hostility. Humboldt, a son of the eighteenth century, was, like Goethe, cosmopolitan in his feelings, without being on that account any less a patriot. Nothing would have shocked him, who spent the best part of his life in Paris, in intercourse with the noblest men of the nation, more than the preponderance of Chauvinism; nothing would have troubled him more than to observe that mental disease suggesting a back-sliding into the barbarism of primitive society which is becoming epidemic over Europe, and more seriously threatens the progress of mankind than the rivalry of dynasties ever could do.

Among the articles of faith with which Humboldt was thoroughly permeated, was that of the unity of the human race. On it he theoretically based his abhorrence of slavery, the worser side of which in practice he had observed in its very home, and he spared no opportunity to make his convictions public. The Abolitionist party in the United States did not fail to make use of so desirable a confederate, and at many an anti-slavery meeting, besides "Uncle Tom's Cabin," brought the "Cosmos" into the fight. Humboldt did not live to see the melancholy drama of the war of secession. The final defeat of the slave-holders and the abolition of slavery would have given him great joy. But how would we have stood before him, the friend of the house of Mendelssohn, who corresponded with Henrietta Herz in the Jewish current hand, if he had heard of the race-persecution we have instituted?

In science we could, however, point with peculiar pride to the insight into the unity of the forces of Nature which has become so clear: to spectrum analysis; to the recognition of the nature of comets, a sequel to his observations in Cumana; and to the establishment of the doctrine of descent, and the associated one of persistent natural selection. To-day, when the nebular hypothesis has, through the mechanical theory of heat, been combined with geology, and the hand of the doctrine of descent is reaching through paleontology over the hiatus of spontaneous generation; when we can so far survey the birth of cosmos out of chaos as to be able clearly to define the really doubtful points—now, perhaps, a "Cosmos" might be written, but no one longer thinks of doing it. Two qualities which Humboldt possessed in the highest degree, and would be missed by us with regret were necessary to it, and can no more be found—the view over the whole field of science, and the careful effort to create beautiful forms. Humboldt would also deeply lament the decay of the historical sense, which often in the growth of science first teaches us the true connection of things.

Since Alexander von Humboldt was a universal naturalist, and thought historically, while William, not less universal in the mental sciences, sometimes acted as a naturalist, the two brothers met at

many points where the natural and mental sciences march upon each other, and together formed, in the measure of the enlarged condition of knowledge, a *universitas litteraria*, as Leibnitz called it in his time. The statues of the two brothers, in whom, by the rarest coincidence, the various faculties of the human mind diverged and were again drawn together, as in a German university, are therefore the most significant ornament of our edifice, and lend it at once, by a speaking symbolism, the character of a palace of science. The situation of this building, opposite the palace of the ruling house, was a significant mark of the capital of the Hohenzollerns. The Humboldt statues confirm and perfect its significance. As fences and troops guard against marauders by night, so do the spirits of these brothers keep watch against the tricks of blockheads. Where William and Alexander von Humboldt are sentries, there will always be the seat of the noblest manly effort, of free investigation and free teaching.

SUGGESTIONS ON SOCIAL SUBJECTS.

PASSAGES SELECTED FROM PROFESSOR W. G. SUMNER'S NEW BOOK, ENTITLED "WHAT SOCIAL CLASSES OWE TO EACH OTHER."

IN the introduction to his little volume, Professor Sumner remarks: "During the last ten years I have read a great many books and articles, especially by German writers, in which an attempt has been made to set up 'the state' as an entity, having conscience, power, and will sublimated above human limitations, and as constituting a tutelary genius over us all. I have never been able to find in history or experience anything to fit this concept. I once lived in Germany for two years, but I certainly saw nothing of it there then. Whether the state which Bismarck is molding will fit the notion is at best a matter of faith and hope. My notion of the state has dwindled with growing experience of life. As an abstraction, the state is to me only All-of-us. In practice—that is, when it exercises will or adopts a line of action—it is only a little group of men chosen in a very hap-hazard way by the majority of us to perform certain services for all of us. The majority do not go about their selection very rationally, and they are almost always disappointed by the results of their own operation. Hence 'the state,' instead of offering resources of wisdom, right reason, and pure moral sense, beyond what the average of us possess, generally offers much less of all these things. Furthermore, it often turns out in practice that 'the state' is not even the known and accredited servants of the state, but, as has been well said, is only some obscure clerk hidden in the recesses of a government bureau into whose power the chance has fallen for the moment to pull one of the stops

which control the government machine. In former days it often happened that 'the state' was a barber, a fiddler, or a bad woman. In our day it often happens that 'the state' is a little functionary on whom a big functionary is forced to depend."

In Chapter I—"ON A NEW PHILOSOPHY: THAT POVERTY IS THE BEST POLICY"—Professor Sumner says: "It is commonly asserted that there are in the United States no classes, and any allusion to classes is resented. On the other hand, we constantly read and hear discussions of social topics in which the existence of social classes is assumed as a simple fact. 'The poor,' 'the weak,' 'the laborers,' are expressions which are used as if they had exact and well-understood definitions. Discussions are made to bear upon the assumed rights and misfortunes of certain social classes; and all public speaking and writing consists in a large measure of the discussion of general plans for meeting the wishes of classes of people who have not been able to satisfy their own desires. These classes are sometimes discontented and sometimes not. Sometimes they do not know that anything is amiss with them until the 'friends of humanity' come to them with offers of aid. Sometimes they are discontented and envious. They do not take their achievements as a fair measure of their rights. They do not blame themselves or their parents for their lot as compared with that of other people. Sometimes they claim that they have a right to everything of which they feel the need for their happiness on earth. To make such a claim against God or Nature would, of course, be only to say that we claim a right to live on earth if we can. But God and Nature have ordained the chances and conditions of life on earth once for all. The case can not be reopened. We can not get a revision of the laws of human life. We are absolutely shut up to the need and duty, if we would learn how to live happily, of investigating the laws of Nature, and deducing the rules of right living in the world as it is. These are very wearisome and commonplace tasks. They consist in labor and self-denial repeated over and over again, in learning and doing. When the people whose claims we are considering are told to apply themselves to these tasks, they become irritated and feel almost insulted. They formulate their claims as rights against society—that is, against some other men. In their view they have a right not only to *pursue* happiness, but to get it; and, if they fail to get it, they think they have a claim to the aid of other men—that is, to the labor and self-denial of other men—to get it for them. They find orators and poets who tell them that they have grievances so long as they have unsatisfied desires. . . . The humanitarians, philanthropists, and reformers, looking at the facts of life as they present themselves, find enough which is sad and unpromising in the condition of many members of society. They see wealth and poverty side by side. They note great inequality of social position and social chances. They eagerly set about the attempt to account for what they see, and

to devise schemes for remedying what they do not like. In their eagerness to recommend the less fortunate classes to pity and consideration, they forget all about the rights of other classes; they gloss over all the faults of the classes in question, and they exaggerate their misfortunes and their virtues. They invent new theories of property, distorting rights and perpetrating injustice, as any one is sure to do who sets about the readjustment of social relations with the interests of one group distinctly before his mind and the interests of all other groups thrown into the background. When I have read certain of these discussions, I have thought that it must be quite disreputable to be respectable, quite dishonest to own property, quite unjust to go one's own way and earn one's own living, and that the only really admirable person was the good-for-nothing. The man who by his own effort raises himself above poverty appears, in these discussions, to be of no account. The man who has done nothing to raise himself above poverty finds that the social doctors flock about him, bringing the capital which they have collected from the other class, and promising him the aid of the state to give him what the other had to work for. . . . On the theories of the social philosophers to whom I have referred, we should get a new maxim of judicious living: 'Poverty is the best policy. If you get wealth, you will have to support other people; if you do not get wealth, it will be the duty of other people to support you.'"

In his second chapter, the author dilates upon the proposition that "A FREE MAN IS A SOVEREIGN, BUT THAT A SOVEREIGN CAN NOT TAKE 'TIPS.'" He discourses as follows: "A free man, a free country, liberty and equality, are terms in constant use among us. They are employed as watchwords as soon as any social question comes into discussion. It is right that they should be so used. They ought to contain the broadest convictions, and most positive faiths of the nation, and so they ought to be available for the consideration of questions of detail. . . . Probably the popular notion is, that liberty means doing as one has a mind to, and that it is a metaphysical or sentimental good. A little observation shows that there is no such thing in this world as doing as one has a mind to. There is no man, from the tramp up to the President, the Pope, or the Czar, who can do as he has a mind to. Moreover, liberty is not a metaphysical or sentimental thing at all. It is positive, practical, and actual. It is produced and maintained by law and institutions, and is therefore concrete and historical. Sometimes we speak distinctly of civil liberty; but if there be any liberty other than civil liberty—that is, liberty under law—it is a mere fiction of the school-men which they may be left to discus. . . . The notions of civil liberty which we have inherited is that of *a status created for the individual by laws and institutions, the effect of which is that each man is guaranteed the use of all his own powers exclusively for his own welfare.* It is not at all a matter of elections, or universal suffrage, or

democracy. All institutions are to be tested by the degree to which they guarantee liberty. It is not to be admitted for a moment that liberty is a means to social ends, and that it may be impaired for major considerations. Any one who so argues has lost the bearing and relation of all the facts and factors in a free state. A human being has a life to live, a career to run. He is a center of powers to work and of capacities to suffer. What his powers may be, whether they can carry him far or not; what his chances may be, whether wide or restricted; what his fortune may be, whether to suffer much or little—are questions of his personal destiny which he must work out and endure as he can; but for all that concerns the bearing of the society and its institutions upon that man, and upon the sum of happiness to which he can attain during his life on earth, the product of all history and all philosophy up to this time is summed up in the doctrine that he should be left free to do the most for himself that he can, and should be guaranteed the exclusive enjoyment of all that he does. If the society—that is to say, in plain terms, if his fellow-men, either individually, by groups, or in a mass—impinge upon him otherwise than to surround him with neutral conditions of security, they must do so under the strictest responsibility to justify themselves. . . . It is not at all the function of the state to make men happy. They must make themselves happy in their own way and at their own risk. The functions of the state lie entirely in the conditions or chances under which the pursuit of happiness is carried on, so far as those conditions or chances can be affected by civil organization. Hence, liberty for labor and security for earnings are the ends for which civil institutions exist, not means which may be employed for ulterior ends. . . . Democracy, in order to be true to itself, and to develop into a sound working system, must oppose the same cold resistance to any claims for favor on the ground of poverty as on the ground of birth and rank. It can no more admit to public discussion, as within the range of possible action, any schemes for coddling and helping wage-receivers than it could entertain schemes for restricting political power to wage-payers. It must put down schemes for making 'the rich' pay for whatever 'the poor' want, just as it tramples on the old theories that only the rich are fit to regulate society. One needs but to watch our periodical literature to see the danger that democracy will be construed as a system of favoring a new privileged class of the many and the poor. . . . In a free state every man is held and expected to take care of himself and his family, to make no trouble for his neighbor, and to contribute his full share to public interests and common necessities. If he fails in this, he throws burdens on others. He does not thereby acquire rights against the others. On the contrary, he only accumulates obligations toward them; and, if he is allowed to make his deficiencies a ground of new claims, he passes over into the position of a privileged or petted person—emancipated

from duties, endowed with claims. This is the inevitable result of combining democratic political theories with humanitarian social theories.

Chapter III. "THAT IT IS NOT WICKED TO BE RICH; NAY, EVEN THAT IT IS NOT WICKED TO BE RICHER THAN ONE'S NEIGHBOR." "We all agree that he is a good member of society who works his way up from poverty to wealth, but, as soon as he has worked his way up, we begin to regard him with suspicion as a dangerous member of society. A newspaper starts the silly fallacy that 'the rich are rich because the poor are industrious,' and it is copied from one end of the country to the other, as if it were a brilliant apothegm. 'Capital' is denounced by writers and speakers who have never taken the trouble to find out what capital is. . . . The great gains of a great capitalist in a modern state must be put under the head of wages of superintendence. Any one who believes that any great enterprise of an industrial character can be started without labor must have little experience of life. . . . Especially in a new country, where many tasks are waiting, where resources are strained to the utmost all the time, the judgment, courage, and perseverance required to organize new enterprises and carry them to success are sometimes heroic. Persons who possess the necessary qualifications obtain great reward. They ought to do so; . . . the ability to organize and conduct industrial, commercial, or financial enterprises is rare; the great captains of industry are as rare as great generals. . . . The aggregation of large fortunes is not at all a thing to be regretted. On the contrary, it is a necessary condition of many forms of social advance. If we should set a limit to the accumulation of wealth, we should say to our most valuable producers, 'We do not want you to do us the services which you best understand how to perform, beyond a certain point.' It would be like killing off our generals in war. . . . Human society lives at a constant strain forward and upward, and those who have most interest that this strain be successfully kept up, that the social organization be perfected, and that capital be increased, are those at the bottom. . . . Those who to-day enjoy the most complete emancipation from the hardships of human life, and the greatest command over the conditions of existence, simply show us the best that man has yet been able to do. Can we all reach that standard by wishing for it? Can we all vote it to each other? If we pull down those who are most fortunate and successful, shall we not by that very act defeat our own object? Those who are trying to reason out any issue from this tangle of false notions of society and of history are only involving themselves in hopeless absurdities and contradictions. If any man is not in the first rank who might get there, let him put forth new energy and take his place. If any man is not in the front rank, although he has done his best, how can he be advanced at all? Certainly in no way save by pushing down any one else who is forced to contribute to his advancement."

Chapter V. "THAT WE MUST HAVE FEW MEN IF WE WANT STRONG MEN." "Undoubtedly the man who possesses capital has a great advantage over the man who has no capital, in all the struggle for existence. . . . If it were not so, capital would not be formed. Capital is only formed by self-denial, and if the possession of it did not secure advantages and superiorities of a high order, men would never submit to what is necessary to get it. . . . The man who has capital has secured his future, won leisure which he can employ in winning secondary objects of necessity and advantage, and emancipated himself from those things in life which are gross and belittling. The possession of capital is, therefore, an indispensable prerequisite of educational, scientific, and moral goods. This is not saying that a man in the narrowest circumstances may not be a good man. It is saying that the extension and elevation of all the moral and metaphysical interests of the race are conditioned on that extension of civilization of which capital is the prerequisite, and that he who has capital can participate in and move along with the highest developments of his time. Hence it appears that the man who has his self-denial before him, however good may be his intention, can not be as the man who has his self-denial behind him. Some seem to think that this is very unjust, but they get their notions of justice from some occult source of inspiration, not from observing the facts of this world as it has been made and exists.

The author expresses the opinion, in Chapter VI, "THAT HE WHO WOULD BE WELL TAKEN CARE OF MUST TAKE CARE OF HIMSELF," and in enforcing this idea he observes: "The fashion of the time is to run to government boards, commissions, and inspectors, to set right everything which is wrong. No experience seems to damp the faith of our public in these instrumentalities. The English liberals in the middle of this century seemed to have full grasp of the principle of liberty, and to be fixed and established in favor of non-interference. Since they have come to power, however, they have adopted the old instrumentalities, and have greatly multiplied them since they have had a great number of reforms to carry out. They seem to think that interference is good if only *they* interfere. In this country the party which is 'in' always interferes, and the party which is 'out' favors non-interference. The system of interference is a complete failure of the end it aims at, and sooner or later will fall of its own expense and be swept away. The two notions—one to regulate things by a committee of control, and the other to let things regulate themselves by the conflict of interests between free men—are diametrically opposed; and the former is corrupting to free institutions, because men who are taught to expect government inspectors to come and take care of them lose all true education in liberty. If we have been all wrong for the last three hundred years in aiming at a fuller realization of individual liberty as a condition of general and widely diffused happiness,

then we must turn back to paternalism, discipline, and authority; but to have a combination of liberty and dependence is impossible."

Chapter VIII is a very spicy discussion "ON THE VALUE AS A SOCIOLOGICAL PRINCIPLE OF THE RULE TO MIND ONE'S OWN BUSINESS," and here the author remarks: "Every man and woman in society has one big duty. That is, to take care of his or her own self. This is a social duty. For, fortunately, the matter stands so that the duty of making the best of one's self individually is not a separate thing from the duty of filling one's place in society, but the two are one, and the latter is accomplished when the former is done. The common notion, however, seems to be that one has a duty to society as a special and separate thing, and that this duty consists in considering and deciding what other people ought to do. Now, the man who can do anything for or about anybody else than himself is fit to be the head of a family; and when he becomes head of a family he has duties to his wife and children in addition to the former big duty. Then, again, any man who can take care of himself and his family is in a very exceptional position if he does not find in his immediate surroundings people who need his care and have some sort of personal claim upon him. If, now, he is able to fulfill all this and to take care of anybody outside his family and his dependants, he must have a surplus of energy, wisdom, and moral virtue, beyond what he needs for his own business. No man has this; for a family is a charge which is capable of infinite development, and no man could suffice to the full measure of duty for which a family may draw upon him. Neither can a man give to society so advantageous an employment of his services, whatever they are, in any other way as by spending them on his family. . . . The danger of minding other people's business is twofold: First, there is the danger that a man may leave his own business unattended to; and, second, there is the danger of an impertinent interference with another's affairs. The 'friends of humanity' almost always run into both dangers. I am one of humanity, and I do not want any volunteer friends. I regard friendship as mutual, and I want to have my say about it. I suppose that other components of humanity feel in the same way about it. If so, they must regard any one who assumes the *rôle* of a friend of humanity as impertinent. The reference of the friend of humanity back to his own business is obviously the next step. . . . Yet we are constantly annoyed, and the Legislatures are kept constantly busy, by the people who have made up their minds that it is wise and conducive to happiness to live in a certain way, and who want to compel everybody else to live in their way. Some people have decided to spend Sunday in a certain way, and they want laws passed to make other people spend Sunday in the same way. Some people have resolved to be teetotalers, and they want a law passed to make everybody else a teetotaler. Some people have resolved to eschew luxury, and they want taxes laid to make others eschew luxury. The taxing power is espe-

cially something after which the reformer's finger always itches. Sometimes there is an element of self-interest in the proposed reformation, as when a publisher wanted a duty imposed on books, to keep Americans from reading books which would unsettle their Americanism; and when artists wanted a tax laid on pictures, to save Americans from buying bad paintings. . . . Amateur social doctors are like the amateur physicians—they always begin with the question of *remedies*, and they go at this without any diagnosis, or any knowledge of the anatomy or physiology of society. They never have any doubt of the efficacy of their remedies. They never take account of any ulterior effects which may be apprehended from the remedy itself. It generally troubles them not a whit that their remedy implies a complete reconstruction of society, or even a reconstruction of human nature. Against all such social quackery the obvious injunction to the quacks is, to mind their own business. . . . We have inherited a vast number of social ills which never came from nature. They are the complicated products of all the tinkering, meddling, and blundering of social doctors in the past. These products of social quackery are now buttressed by habit, fashion, prejudice, platitudinarian thinking, and new quackery in political economy and social science. . . . Society, therefore, does not need any care or supervision. If we can acquire a science of society based on observation of phenomena and study of forces, we may hope to gain some ground slowly toward the elimination of old errors and the re-establishment of a sound and natural social order. What we gain that way will be by growth, never in the world by any reconstruction of society on the plan of some enthusiastic social architect. The latter is only repeating the old error over again, and postponing all our chances of real improvement. Society needs, first of all, to be freed from these meddlers; that is, to be let alone. Here we are, then, once more back at the old doctrine—*laissez faire*. Let us translate it into blunt English, and it will read, 'Mind your own business.' It is nothing but the doctrine of liberty. Let every man be happy in his own way. If his sphere of action and interest impinges on that of any other man, there will have to be compromise and adjustment. Wait for the occasion. Do not attempt to generalize those interferences, or to plan for them *a priori*. We have a body of laws and institutions which have grown up as occasion has occurred for adjusting rights. Let the same process go on. Practice the utmost reserve possible in your interferences, even of this kind, and by no means seize occasion for interfering with the natural adjustments. . . . To mind one's own business is a purely negative and unproductive injunction; but, taking social matters as they are just now, it is a sociological principle of the first importance. There might be developed a grand philosophy on the basis of minding one's own business."

Chapter IX considers "THE CASE OF A CERTAIN MAN WHO IS

NEVER THOUGHT OF." "Almost all legislative effort to prevent vice is really protective of vice, because all such legislation saves the vicious man from the penalty of his vice. Nature's remedies against vice are terrible. She removes the victims without pity. A drunkard in the gutter is just where he ought to be, according to the fitness and tendency of things. Nature has set up on him the process of decline and dissolution by which she removes things which have survived their usefulness. Gambling and other less mentionable vices carry their own penalties with them.

"Now, we can never annihilate a penalty. We can only divert it from the head of the man who has incurred it to the heads of others, who have not incurred it. A vast amount of 'social reform' consists in just this operation. The consequence is, that those who have gone astray, being relieved from Nature's fierce discipline, go on to worse, and that there is a constantly heavier burden for the others to bear. Who are the others? When we see a drunkard in the gutter we pity him. If a policeman picks him up, we say that society has interfered to save him from perishing. 'Society' is a fine word, and it saves us the trouble of thinking. The industrious and sober workman, who is mulcted of a percentage of his day's wages to pay the policeman, is the one who bears the penalty. But he is the Forgotten Man. He passes by, and is never noticed, because he has behaved himself, fulfilled his contracts, and asked for nothing.

"The fallacy of all prohibitory, sumptuary, and moral legislation is the same. A and B determine to be teetotalers, which is often a wise determination, and sometimes a necessary one. If A and B are moved by considerations which seem to them good, that is enough. But A and B put their heads together to get a law passed which shall force C to be a teetotaler for the sake of D, who is in danger of drinking too much. There is no pressure on A and B. They are having their own way, and they like it. There is rarely any pressure on D. He does not like it and evades it. The pressure all comes on C. The question then arises, Who is C? He is the man who wants alcoholic liquors for any honest purpose whatsoever, who would use his liberty without abusing it, who would occasion no public question, and trouble nobody at all. He is the Forgotten Man again, and, as soon as he is drawn from his obscurity, we see that he is just what each one of us ought to be.

"The doctrine which we are discussing turns out to be in practice only a scheme for making injustice prevail in human society by reversing the distribution of rewards and punishments between those who have done their duty and those who have not.

"It is plain that the Forgotten Man and the Forgotten Woman are the real productive strength of the country. The Forgotten Man works and votes—generally he prays—but his chief business in life is to pay. His name never gets into the newspapers, except when he

marries or dies. He is an obscure man. He may grumble sometimes to his wife, but he does not frequent the grocery, and he does not talk politics at the tavern. So he is forgotten. Yet who is there whom the statesman, economist, and social philosopher, ought to think of before this man? If any student of social science comes to appreciate the case of the Forgotten Man, he will become an unflinching advocate of strict scientific thinking in sociology, and a hard-hearted skeptic as regards any scheme of social amelioration. He will always want to know, Who and where is the Forgotten Man in this case, who will have to pay for it all?

"Certainly there is no harder thing to do than to employ capital charitably. It would be extreme folly to say that nothing of that sort ought to be done, but I fully believe that to-day the next most pernicious thing to vice is charity in its broad and popular sense."

THE HABITATION AND THE ATMOSPHERE.

By M. R. RADAU.

IN a former article we endeavored to elucidate some of the principles which have been developed from the later researches and experiments on the relations of our clothing with the atmosphere (see "Popular Science Monthly," October, 1883). The house, also, may be regarded as a kind of clothing, as a large and ample garment, designed to regulate our relations with the surrounding medium, and to deliver us from its tyranny, but not to isolate us. It ought not to deprive us of air, though that point is too often forgotten. Fortunately, no voluntary prison is so tightly calked up that air from out-of-doors does not find entrance without our perceiving it. The fact that water will readily penetrate a wall or ceiling is known to all, for they can see the spots it makes; but the air that passes through walls is not seen, and so we imagine that it does not penetrate them. This is a mistake. Walls would not prevent us from being in communication with the outside air, even if no cracks were left around the doors and windows. If water can find a way through them, what is to hinder a subtile gas from doing the same? The porosity of walls is very far from being an evil; and we shall shortly see that it is necessary to prevent houses being damp.

A very simple experiment by Dr. Pettenkofer illustrates the permeability of building materials. He took a cylinder of dry mortar twelve millimetres (4·7 inches) long and one third as thick, and waxed all of it except the ends, in which he fastened two glass funnels, one of which was extended by an India-rubber tube, while the other terminated in a very fine orifice. Blowing through the India-rubber

tube, he was able to drive the air through the cylinder with force enough to extinguish a candle at the other extremity. Similar results may be obtained with wood and such varieties of stones as allow air to pass through them without difficulty; while other stones, like compact limestones, are hardly permeable.

All materials become impermeable to the air when they are wet. The experiment with the cylinder of mortar will not be successful if the mortar is moistened. It has also been found less easy to drive moisture through bricks and mortar than to make air pass through them; only a few drops of the liquid can be made to appear on the free surface. Water is therefore not easy to dislodge from the pores it has occupied, and is at most removed very slowly by evaporation. But, when water stops the pores, it prevents the air from circulating through them—a mischievous effect upon the permeability of building materials, which is more perceptible in proportion as their grain is finer and more compact.

In ordinary weather, and when they are dry, walls perspire. They are continually traversed by feeble atmospheric currents, which renew the air of closed rooms and rid it of the moisture with which it is loaded. The atmosphere of a house is saturated with moisture by the respiration and perspiration of its inmates, and by the water daily used in housekeeping, even if we do not take account of the dew that is deposited whenever some air from without gets into cold rooms. This moisture, which is always undergoing renewal, ought to be absorbed by the walls, to be evaporated from the outside, under the action of the sun and wind. For this reason it is well for building materials to be porous and permeable, and for them to interpose no obstacle to the circulation of the air which is depended upon to promote evaporation. This remark is especially applicable in the North, where the windows can not always be wide open; it is perhaps of less importance in the South.

The moisture which the walls receive from the exterior atmosphere, from fogs and rain, generally disappears quickly enough under the operation of the winds that constantly lick the surface of the house. But the moisture that comes from within, which is deposited on the walls of poorly ventilated rooms, passes away with difficulty when the walls are not porous. Even the heating apparatus only causes it to change its place, by leaving the surfaces that become warmed and settling farther away where the heat has not yet reached. Inconveniences from interior moisture are especially sensible in newly built houses, where the mortar still contains a large proportion of water, and in ground-floors built on a damp soil, which become impregnated by capillarity. The water stops up the invisible channels through which the air should circulate, and the wall remains damp notwithstanding the evaporation that takes place at the surface, to the great harm of the inmates. Like wet clothes, damp walls are un-

healthy because the water they contain increases their conductibility, and, consequently, the flow of heat from within outward; and also because evaporation absorbs or neutralizes much heat. M. Bouchardat, remarking in his "Treatise on Hygiene" on the exposure to which the tenement population are subjected in wind-penetrated Mansard-roofs and in damp basements, adds that the commissioners of unhealthy dwellings are wrong when they rank overcrowding and uncleanliness among the worst sources of danger.

Dr. Pettenkofer calculates that a house having a cellar and basement and two stories of five rooms and a kitchen each, would take 800,000 kilogrammes of bricks, and that these would hold about 40,000 kilogrammes of water. The mortar, although less bulky, would hold as much more water. Thus, the entire masonry would hold, in a house just built, 80,000 kilogrammes or eighty cubic metres of water—a quantity which it is by no means easy to drive out. Among the various means that have been devised for quickly drying the walls of newly-built houses preparatory to tenants moving in, only those can be of real effect that depend on the employment of heat combined with an active aëration. The question is wholly one of promoting ventilation. The lower the temperature, the greater the quantity of air that is needed. At 50° Fahr. a cubic metre of air, which may be already supposed to be three fourths saturated, contains seven grammes of vapor, and is only capable of receiving a little more than two grammes more. Thus, nearly 40,000,000 cubic metres of air at 50° will be needed to absorb the 80,000 kilogrammes of water in the masonry. A moderate wind might, it is true, bring this volume of air in contact with the exposed surface in the course of twenty-four hours; but it is evident that the moisture can not be carried off any faster than it can get through the thickness of the wall to the outer surface; and, when this has to be done, the time required for a more or less complete desiccation would be very long. A suitable degree of heating would greatly hasten the drying, provided the air were continually renewed. If, for example, the temperature of the room were raised to 68° Fahr., the effect—depending partly on the increased capacity of the air to absorb vapor, and partly on the greater rapidity of ventilation—would be five or six times as great.

Aëration is thus the sovereign remedy for the moisture of dwelling-houses, and it is favored by the use of porous materials. Viewed with respect to this point, direct determinations of the porosity, permeability, and hygroscopicity of different building materials are of great interest. Messrs. F. and E. Putzeys, in their work on "Hygiene in the Building of Private Houses," have compiled nearly all that has been published on this subject. It appears from their tables that, in the stones most usually employed, the pores occupy an important fraction of the whole volume. According to Hunt, the decimal of porosity is from 0·07 to 0·20 for some sandstones, from 0·06 to 0·14 for

various dolomites, and 0·30 for the soft Caen limestone and Maltese sandstone. These figures do not, however, permit us to predict the relative permeability of walls into which the stone in question may enter, for that will depend as essentially on the proportion of mortar used and the kind of wash or plaster that is put over the stones, as on the kind of stone employed. It must, then, be determined by direct experiments. These are not wanting. Märker has shown that walls of brick let more air through than walls of cut sandstone. Arranged in the order of increasing permeability, the building materials here mentioned would stand—sandstones, rough stones, limestones, brick, calcareous tufa, and adobe. Adobe has been found to be twice as permeable as burned brick, having a porosity of sixty per cent, while brick has only twenty-five per cent, by volume. Mr. Lang has made more complete researches on the co-efficient of permeability of different materials, and puts calcareous tufa at the head of his table. Then follow, in the order of decrease, bricks of slag, pine-wood, mortar, *béton*, hand-made bricks, green sandstone, molded plaster, oak-wood, and enameled bricks. Plaster is extremely compact, and little favorable to natural ventilation.

Paints, washes, and paper-hangings diminish the permeability of walls. The following surfaces are mentioned by Lang, in the order of their increasing effects: whitewash, mastic, glazed papers, common papers, and oil-colors. Common papers are more impermeable than glazed papers, according to Messrs. Putzeys, on account of the greater quantity of starch with which they are impregnated.

Indispensable as is the renewal of the air as a means of preventing moisture in dwellings, it is still more so as a precaution against impurities of every kind that would finally make the atmosphere unfit for respiration. It is, then, important to learn by what sign we may know when an atmosphere is vitiated, and what is the volume of air which a man requires for free breathing in a close room. Normal air, according to the mean of the results of five years of observations at the observatory of Mont Souris, contains about three ten-thousandths by volume of carbonic acid. Immense quantities of this gas are, however, produced in cities by the respiration of the inhabitants and by the fires, but the whole is so rapidly removed by the winds that the atmosphere is not sensibly vitiated by it; and it is not necessary to estimate the proportion of carbonic acid, even in the most densely crowded localities, at more than four ten-thousandths.

In an occupied inclosure, like a sleeping-room, a school-room, or a public assembly-hall, the air undergoes a progressive change through the consumption of oxygen and by exhalations from the lungs and the skins of the people; and, unless a sufficient ventilation is kept up, it will in time become unfit for respiration. This will be the case when the impurities with which the atmosphere is charged become perceptible to the smell and provoke the uneasiness which is usually attributed

to a close atmosphere. It is generally agreed that this condition is reached when the proportion of carbonic acid approaches one thousandth.* Observation shows, in fact, that the proportion of carbonic acid increases in the same degree as the insalubrity of the air, and may, up to a certain point, afford a measure of it; but the inconvenience we suffer from bad air is in reality attributable rather to the putrescible organic products of respiration and transpiration which it contains. According to Péclet, the air driven out from the ventilating chimneys of crowded rooms exhales an odor so noxious that it can not be borne with safety, even for a short time. According to some chemists, the disagreeable odor that characterizes close air is due to a particular substance possessing an alkaline reaction and the property of giving off ammonia, which escapes from the lungs.† The real culprits are these miasms which affect the smell. The carbonic acid, which is comparatively an inoffensive gas, only indicates the change the air has undergone. The experiments of MM. Regnault and Reizet go to show that an animal can live in an atmosphere containing seven hundredths of carbonic acid, provided the proportion of oxygen is maintained at twenty-one hundredths. Animals have been observed to perish in a tight inclosure even when the carbonic acid is eliminated as fast as it is formed, and the lost oxygen is restored; and Mantegazza has shown that if two birds are placed under two different bell-glasses, and the carbonic acid formed by one is absorbed by quicklime, and the organic matter exhaled by the other is taken up by animal charcoal, the latter bird will survive considerably longer than the former. We add that Dr. Pettenkofer has been able to breathe for several hours, without inconvenience, air containing one hundredth of carbonic acid developed, not by respiration, but by a chemical process. These facts indicate that the few thousandths of carbonic acid diffused in it are not the cause of the effects produced by an atmosphere vitiated by respiration. The oxygen content diminishes in nearly the same proportion as carbonic acid is developed; but the effects produced by "close air" can not be explained by the deficiency—say of one per cent—of oxygen; that may be remedied in part by more active breathing.

Carbonic acid has sometimes been wrongfully charged with effects which were really due to a small proportion of carbonic oxide, a product of imperfect combustion and of the reduction of carbonic acid. Carbonic oxide is a deadly poison, and destroys the red globules of the blood. To its disengagement may be attributed the unhealthy effects

* According to M. de Chaumont's observations in English barracks, the odor begins to be perceptible when the proportion reaches 0·0008; and this hygienist is inclined to reduce the admissible proportion to 0·0006; but I believe it sufficient to adopt one thousandth as a limit which we shall be fortunate if we never exceed in practice.

† It blackens sulphuric acid, discolors permanganate of potash, and communicates to water in solution a fetid odor (A. Proust, "Traité d'Hygiène").

of cast-iron stoves, effects from which sheet-iron stoves, which are not pervious to it, are free; and it is one of the products of the combustion of poor illuminating gas. It is, nevertheless, customary to measure the degree of insalubrity which any atmospheric medium has reached by the quantity of carbonic acid it contains. This is found to increase rapidly in school-rooms, hospital-wards, and assembly-rooms of all kinds, but not nearly so rapidly, unless the room is extremely close, as the gas is actually developed by the life-processes of the inhabitants of the rooms. This fact indicates that, even in rooms regarded as close, a considerable renewal of air is all the time going on by natural or spontaneous ventilation.

Dr. Pettenkofer has made an ingenious use of the estimation of the proportions of carbonic acid to measure the spontaneous ventilation, or the speed with which the air gradually renews itself in rooms. It is sufficient for this purpose to develop artificially in a room an exactly ascertained quantity of the gas, and to determine by repeated analyses the quantity of acid that disappears in a certain time. The method is a good one, provided there is no opportunity for the acid to be absorbed by fresh mortar. By gauging in this manner the ventilation of a number of places, and then observing in the same places the degree of alteration in the atmosphere resulting from the presence of a given number of persons, Dr. Pettenkofer found that the atmosphere remained of a satisfactory quality when it was renewed at the rate of sixty cubic metres an hour per head. The proportion of carbonic acid continued under these conditions to be less than a thousandth. Experiments were made in a room with brick walls, and having a capacity of seventy-five cubic metres. On the first day when the temperature was 66° in the room and below the freezing-point out-of-doors—the difference being nearly 36°—the rate of change (seventy-four cubic metres) was sufficient to renew all the air in the room in an hour; with a good fire in the stove, the rate of ventilation was raised to ninety-four cubic metres an hour. With paper pasted over the joints of the doors and windows, it fell to fifty-four cubic metres. On another day, when the difference between the inner temperature and that out-of-doors was about seven degrees, the rate of ventilation was only twenty-two cubic metres an hour; and with a window half open it was only increased to forty-two cubic metres; thus an opening of eighty square decimetres was of less effect upon ventilation than the simple transpiration through the walls assisted by a difference of about 36° between the outer and inner temperatures. A calculation based on these experiments indicates that a difference in temperature of 1° C. (1·8° Fahr.) causes to pass every hour about two hundred and forty-five litres of air for each square metre of exposed wall-surface.

The question of the volume of air needed by a man for free respiration is a complex one, on which hygienists do not readily agree. The answer to it must depend, not only on the exterior conditions in view,

but also upon the limit of variation, or tolerance, which is regarded as admissible in the normal composition of the air. In a room hermetically closed, where the volume of available air is limited by the capacity of the inclosure, the proportion of carbonic acid will soon reach the one thousandth, which we have adopted as the tolerable limit; and the more speedily as the size of the room is diminished, the more tardily as it is enlarged. The volume of air required will also evidently be proportioned to the time the man stays in the room. Assuming that about twenty litres of carbonic acid are exhaled in an hour from the lungs of an adult man, we find that he will require about thirty-three cubic metres of fresh air every hour; for this quantity of air already has a normal content of thirteen litres of carbonic acid; and the addition to this of the twenty litres exhaled will bring up the whole amount to thirty-three litres, or the one-thousandth part of the volume of air, which we have accepted as the tolerable limit. Consequently the space a person must have, if he is to live in a really close room for an hour, is thirty-three cubic metres; if he is to live there two hours, sixty-six cubic metres. More will be needed if lamps or gas-lights are kept burning in the room, for a candle in burning will consume as much oxygen as a man; but the carbonic acid produced by combustion is not so dangerous as are the exhalations from a living being. The case of a perfectly close room will, however, never be realized; for, however tightly we may close the doors and windows, the air will always get in through some crack, and, if there are no cracks, it will penetrate through the walls. The most thoroughly calked room is not proof against the natural ventilation that results from inequalities of temperature. Houses are great centers of draughts in cold weather, and are permeated by a spontaneous ventilation that is dependent at once on the degree to which the outer atmosphere is agitated, on the number and sizes of the doors and windows, on the condition of the chimneys, and lastly on the permeability of the walls. It may be increased by a suitable distribution of ventilators, and is aided by the draught of the chimneys when fires are kindled in them; but fires may be regarded as artificial means of ventilation. These agencies of natural ventilation diminish in a notable degree the danger of the air within houses stagnating, and will always prevent its becoming vitiated to the extent that might otherwise be apprehended from the causes of contamination which we have reviewed. Their effect should be taken account of in estimating what extent of artificial ventilation may be required; otherwise, we might make exaggerated provisions for it.

When an inclosure containing a given number of persons is subjected to a regular ventilation, there is established, at the end of a certain time, a permanent *régime;* the adulteration of the air, having reached a certain limit, does not vary any more, the noxious gases being eliminated as fast as they are developed. The proportion of

carbonic acid is from that time constant; we obtain it simply by assuming that the acid disengaged is distributed through the volume of air introduced by the ventilation. This proportion-limit is, then, independent of the disposable cubic space. A ration of forty cubic metres of air, for example, with a production of twenty litres of carbonic acid, to which are added the sixteen litres of acid contained in the forty cubic metres of fresh air, gives the proportion of 0·0009, whatever may be otherwise the disposable space. The capacity of the inclosure plays no other part than that of delaying the moment when the constant *régime* is established; the space acts as a reservoir which is gradually filled till it contains the same proportion of acid as the current of air that traverses it; but, once *saturated*, it intervenes no more in the course of the phenomenon. The advantage of a considerable cubic space consists, then, chiefly in the fact that it retards the approach of the moment when the alteration of the air attains the limit which it will not pass. This consideration becomes of some importance in fixing the size of rooms that are to be occupied only for a definite number of hours at a time; for it will be always possible to arrange matters so that the proportion-limit shall not be reached before the end of the contemplated time.

Let us suppose, for example, that the ventilation can supply six cubic metres of fresh air per person per hour. This is the ration of air which, according to Péclet, might be sufficient in case of extremity, because six cubic metres of air, half saturated at 60°, can absorb the thirty-five or forty grammes of vapor given out by transpiration. The fresh air containing already a proportion of 0·0004 of carbonic acid, to which respiration adds 0·0033, we find that the proportion-limit will be 0·0037. This limit will be almost reached and the *régime* will be constant when the air has been renewed three times, for the proportion of air will then exceed 0·0035. If the allotted space is only one cubic metre, as we know happens sometimes to be the case in theatres and other assembly-halls, a half an hour will be long enough to bring about this state of things; if the cubic space is increased to ten cubic metres, five hours will be required, and ten hours if it is increased to twenty cubic metres, to reach the same degree of alteration. Such, then, would be the effect of a ventilation at the rate of six cubic metres an hour, according to the capacity of the building. By raising the ration of air to thirty cubic metres, the proportion-limit becomes 0·0011, and we may assume that this has been reached when the air has been renewed twice (the real proportion being then 0·0010). This will happen at the end of four minutes in a space of one cubic metre, after forty minutes in ten cubic metres, etc. But the prolongation of time obtained under these circumstances is not of the same importance as in the preceding case, for the limit of 0·001 is a characteristic of respirable air. With so energetic a ventilation as this, the consideration of cubic space becomes a minor affair; but it

is of great importance when the only dependence is upon natural ventilation, for that is greatly facilitated by any increase of the extent of exposed surfaces, and of doors and windows. We should also keep in view that a like quantity of air will more readily traverse a large than a small space without producing inconvenient currents; and that the air in a large space requires less frequent renewal, and does not have to be kept in as rapid motion. Natural ventilation, which is uniform and almost insensible, must not be confounded with draughts and currents of air, with the injurious effects of which all are acquainted.

The rules as to the amount of space that should be allowed in connection with natural ventilation are various and indefinite. Aëration from this source can not always, however, be depended upon; and even the opening of windows on opposite sides of an apartment frequently fails to produce the changes of air that are needed. General Morin, who has distinguished himself as an apostle of ventilation, and who made numerous experiments bearing upon the subject, has given the following estimates of the volume of air that should be withdrawn and introduced every hour, for each person, in public institutions of different kinds: Children's schools, twelve to fifteen cubic metres; schools for adults, twenty-five to thirty cubic metres; amphitheatres, thirty cubic metres; assembly-halls and long-continued meetings, sixty cubic metres; play-houses, forty cubic metres; barracks, thirty cubic metres during the day, forty to fifty cubic metres at night; hospitals for the ordinary sick, sixty to seventy cubic metres; hospitals for the wounded and for women in childbirth, one hundred cubic metres; the same in times of epidemic, one hundred and fifty cubic metres; prisons, fifty cubic metres; stables, one hundred and eighty to two hundred cubic metres. These numbers certainly represent the maximum of reasonable demands; and M. Bouchardat thinks that they are exaggerated and not justified by clinical experience. Besides effecting the renewal of the air, ventilation also furnishes the means of obtaining a nearly constant temperature—in winter by means of the circulation of hot air through the house, in summer by air drawn from the cellar. The latter method is quite effective for securing an agreeable temperature in hot weather without much expense, whenever a sweet, dry cellar can be had. The cabinet of the Conservatoire des Arts et Métiers, in Paris, is kept cool in this way, the draught of air being promoted by gas-jets kept burning in the ventilating shafts; as is also M. Daville's laboratory at the Normal School, where the opening of a few squares in the glass-roof furnishes the required stimulus to the circulation. Similar principles have been adopted at the palace of the Corps Législatif. The subject of applying the artificial refrigeration of the air in colonial life in hot countries has been studied by M. Dessoliers, and elaborated by him with a number of ingenious devices, among which the storing of cold night-air for use during the day plays a part.

In temperate climates the principal object of ventilation is the replacement of vitiated air with fresh. Artificial ventilation is produced either by inducing a movement of air by means of draught-chimneys, or by forcing in air through the agency of mechanical ventilators. A trial has been made at the Lariboisière Hospital of a system of ventilation in which the air is drawn from the roof and forced into flues that ramify into the several halls to be ventilated. At the moment of entering the halls the air is heated by being brought in contact with steam-pipes, so that a uniform temperature of 78° is maintained in the wards, with an atmosphere free from odor. Notwithstanding purity of air is secured, the mortality in this institution is not inferior to that in non-ventilated hospitals. This is attributed by M. Bouchardat to the mischievous influence of the high temperature which they endeavor to maintain. He favors heating and ventilation by open fire-places. This method is preferred in London, where fires are kept up in summer as well as in winter, at least in the principal office of the institution, and the windows are opened at all times when it is possible, while mechanical ventilating apparatus is used only exceptionally. The air, sucked in by the strong draught of the chimneys, enters by the joints of the doors and windows. The patients enjoy the sight of the fire and the pleasant feeling of direct radiation, while they collect around the hearths and breathe an air that has not been changed by contact with a heated surface. Possibly the English go too far in this direction. "The importance of pure air," says M. Proust, "has perhaps been exaggerated in some cases by the English physicians, whose example the Americans have followed. It is advisable, according to them, to leave the larger openings, no matter what the weather may be, the windows of dormitories and bedrooms, open during the night. These principles, almost universally observed in the countries of which we speak, entail, in our opinion, great inconveniences." There is really some danger in exposing one's self to cold during sleep.

The study of the questions of heating and ventilation has made considerable progress in France during the last fifteen or twenty years. The construction of numerous school-houses has especially been the occasion of many praiseworthy improvements, but much still remains to be done. Dr. Larget, in an interesting work on rural habitations, has pointed out an apparent relation between the number of openings indicated in the tax-list of doors and windows and the mortality. The general average, for France, of the number of openings per inhabitant, is one and a half. In one hundred departments, in which the number is less than the mean, fifty-five show a higher mortality, and forty-five a mortality equal to the average; while, in a hundred departments in which the number is greater than the mean, sixty show a lower rate of mortality than the average, and only twenty-five a higher rate.

Another point which is too easily forgotten is that, like the walls, floors are permeable to the air. The atmosphere is not bounded by

the level of the soil, but extends below it to a considerable depth. The most compact soils include a considerable volume of air, as well as an ever-varying quantity of moisture. When we pour water into a vessel full of well-packed gravel, and displace the air which is present, we find that it generally forms one third of the total volume of the mass. The porosity of the earth sometimes reaches fifty per cent; and miners and well-diggers accidentally buried under cavings-in have sometimes been known to live for several days by the aid of the air circulating through the earth.

Porous soil does not become impermeable to air till below the level at which the subterranean water ceases to exist. Frozen ground does not lose its porosity by the solidification of the water. Incessant interchanges are taking place between the underground air and the free atmosphere. It is by such means that infiltrations of lighting-gas impregnate the soil of the street, penetrate sewers, and cause ills which are wrongly attributed to typhoid affections; and this is most liable to take place in winter when the rise of gas from the soil is promoted by the draught of the chimneys. Ventilation is thus partly carried on through the floor, to such an extent that the atmosphere of a room sometimes contains from ten to fifteen per cent of air from the ground. Hence the danger from impurities absorbed by the soil. They rise, pitilessly returning from the earth, as if to chastise us for our carelessness. The air included in a garden-soil, and generally in any soil rich in organic matters, always contains a strong proportion of carbonic acid. At the same time the oxygen is in diminished quantity, proving that the carbonic acid proceeds from slow combustions, and not from subterranean emanations. According to the observations of Pettenkofer, Fleck, and Fodor, the proportion of acid increases with the depth, and at a few yards beneath the surface sometimes exceeds ten per cent. This presence of carbonic acid is a sign of the activity of the life in the soil. We do not know the exact manner in which the soil and subsoil intervene in the etiology of endemic diseases and the appearance of epidemics. It is a subject of active controversy. We can, nevertheless, approve the teaching of the hygienists who advise us to render our dwellings independent of the soil-air by making provisions for aëration under the basements, or by making the floors impermeable.

Parks and gardens are beneficial, not only because they give a degree of shade and coolness in hot weather, but also because vegetation absorbs waste matter and purifies the soil, and thus diminishes the liability to epidemics.* It is well, for other reasons, to increase these oases in cities where the air is not directly vitiated. But the quantity of oxygen which the plants disengage is too small to be made an object. The phenomena of vegetation are extremely slow of accomplishment. Vast spaces and a long time are needed to produce the grass and the wood

* We may here take notice of a scheme of M. Autier's for serving the citizens of Paris in their houses with pure air brought through pipes from the forests.

that are consumed in a few hours. Oxygen is absorbed more rapidly than it is set free. We shall also have to give up the prevalent idea that a little verdure can improve the atmosphere of a room. The advantage of plants, as Dr. Pettenkofer remarks, is rather in their moral than in their physical influence. Public gardens are also desirable because they enliven the view. Even on hygienic grounds, we should be careful not to underestimate the importance of whatever acts upon the mind. We have endeavored, in this and a former essay,* to study clothing and the habitation, with particular reference to their relations with the atmosphere; but, even as thus limited, the subject has proved to be a very complex one, and in our progress we have struck upon more than one question that is still imperfectly elucidated. It may, however, not have been without use to attract attention to these questions, which demand new investigations. Hygienic societies are multiplying; departments of hygiene have been created in numerous cities; and the hygienic conferences which have been held at Paris, Turin, and Geneva, attest the growing interest that attaches to the development of a science all of whose conquests redound to our physical and moral profit. Every facility should be given for widening its scope and extending its sphere of action. Diseases that might have been avoided constitute the heaviest taxes that can be laid upon a city.—*Translated for the Popular Science Monthly from the Revue des Deux Mondes.*

A BELT OF SUN-SPOTS.

By GARRETT P. SERVISS.

EVERYBODY who watched the sun with a telescope last summer must have wondered at the great belt of spots lying across the southern part of the disk during the last half of July. Several of the spots and groups were of extraordinary size, and their arrangement was very singular. When the belt extended completely across the sun, there was visible at one time almost every characteristic form that sun-spots present. There was the yawning black chasm with sharply defined yet ragged edges, vast enough to swallow up the whole earth, with room to spare, and surrounded by a regular penumbral border as evenly shaded as an artist could have made it; there was the double or triple spot whose black centers, though widely separated from one another, were tangled, as it were, in one twisted and torn veil of penumbra, or connected by long, shadowy bands; there was the monstrous spot of grotesque form surrounded by a crowd of smaller spots of even more fantastic shape, and enveloped in a broad, irregular penumbra as *bizarre* and wonderful as the mighty sun-chasms inclosed

* "Popular Science Monthly" for October, 1883, p. 787.

in it; there was the great spot, often of singular outline, accompanied outside its shadowy borders by one or more swarms of minute black specks pitting the white photosphere in the most extraordinary fashion; there was the huge group, visible even to the unassisted eye, and consisting of half a dozen or more large spots intermingled with smaller ones whose number seemed to defy counting, and enveloped in a penumbral cloak of becoming amplitude; there, near the edges of the disk, were the crinkling lines and heaped-up masses of faculæ, the mountainous hydrogen-flames which marked the places where the intensest solar action was going on—in short, there was a panorama in which every variety of sun-spot seemed to be passing in a gigantic procession across the disk. And what a procession it was!—long enough, nearly, to reach from the earth to the moon and back again three times!

But the most extraordinary feature of this great solar display was the linear arrangement of the spots making a belt, or band, that half encircled the sun; there was also a noticeable regularity in the distances separating the groups composing this singular belt, and this peculiarity increased the likeness to a procession which must have impressed every observer who beheld the gradual march of the sun-spot army across the

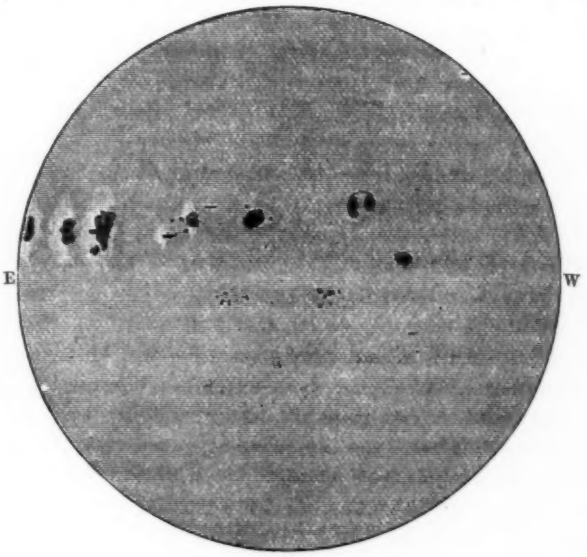

FIG. 1.

solar disk. It was like watching a parade of masqueraders; each company of spots had its own characteristic and conspicuous make-up, and each kept its place in the line at a nearly invariable distance from the group in front of it and the one that followed.

The separate spots and groups did not, however, present an unvarying appearance. There was change as well as variety in this un-

paralleled pageant on the sun. Changes were continually going on in the shape and even the size of the spots, and in the configuration of the different members of the groups—minor evolutions in the ever-advancing column. New spots of small size made their appearance in the neighborhood of larger ones; and in one instance, at least, a perfect swarm of little spots broke out near one of the largest components of the belt, as if the surface of the sun had been suddenly punctured by huge needles.

A very good idea of the appearance of the band of spots, and of their progressive motion from east to west with the revolution of the sun, as well as of the principal changes that took place in their form and arrangement, can be obtained from the series of sketches accompanying this article. The originals of these sketches I made at the time the spots were visible, and they represent with approximate accuracy the appearance of the spots with a magnifying power of sixty-five diameters. They do not, however, by any means show all the details visible with such a power. With higher magnifying powers the crowd of details in some of the larger groups was so great and confusing as to defy the power of the pencil to represent them. Some remarkable phenomena were also observed with the spectroscope dur-

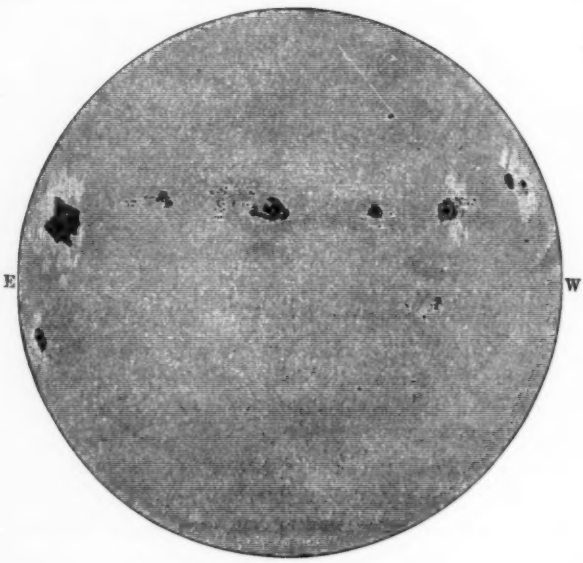

FIG. 2.

ing this sun-spot display. When the huge group, seen near the left-hand edge of the sun in Fig. 2, was just coming around the edge, its approach was announced by an outburst of gas which M. Thollon observed as a small but extremely brilliant protuberance, that exhibited very marked displacement of the C-line toward the violet end of the

spectrum. In a communication to the French Academy of Sciences, M. Thollon says that an hour before his observation on the C-line he had observed in the same region a slighter displacement not only of the lines of hydrogen and of the *b*-group but also of the coronal line 1,474. He observed on several days other remarkable spectroscopic phenomena, and noticed that nearly the whole southern half of the sun's disk gave manifest signs of violent agitation. In view of these facts, it seems surprising that little apparent effect was produced upon the earth by these solar outbursts. Two or three times in 1882 the earth responded instantly with magnetic storms and brilliant auroral displays to the solar activity, but this year the great sun-spots and their accompanying phenomena have shown comparatively little power to affect terrestrial magnetism.

Fig. 1 shows the sun as it appeared on the 16th of July, when the advancing procession of spots had reached two thirds of the way across the disk.

Fig. 2 represents the sun on the 20th of July, when the spot belt extended completely across the disk.

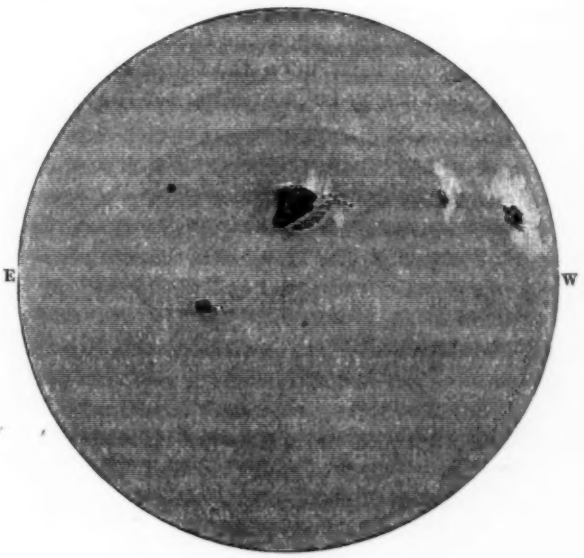

FIG. 3.

Fig. 3 shows the appearance of the sun on the 25th of July, when more than half of the procession had disappeared around the western edge, and the great group bringing up the rear was near the meridian.

In the latter part of August and early in September a row of spots, principally in the southern hemisphere, was again seen upon the sun, but it was shorter, more crooked, and composed of fewer spots and groups, than the great belt of July.

There is one point of view from which the sun-spot belt just de-

scribed appears particularly interesting, and that relates to the supposed resemblance between the larger planets, and more especially Jupiter, and the sun. Everybody knows that Jupiter has a conspicuous dark-colored belt on each side of his equator, for those belts are one of the commonest objects of celestial sight-seeing. Saturn too has belts similarly situated, although they are less conspicuous than those of Jupiter. All the trustworthy evidence we have points to the conclusion that these huge planets are yet in a state which has more points of resemblance to the condition of a sun than to that of a cool and solid globe. There can be little doubt that Jupiter is surrounded by a cloud-laden atmosphere of great depth, and that his geological development, so to speak, is in a stage much earlier than any whose former existence is recorded in the present rock strata of the earth. In other words, Jupiter probably has not yet a continuous solid crust, even if the formation of such a crust has been begun. But, accepting the nebular hypothesis, we must conclude that Jupiter is gradually cooling and contracting, and that eventually he will have as solid a surface as the earth's. He seems, then, to be in a transition state between a luminous sun and an opaque world, and, if so, his present condition may throw light upon the future condition of the sun, just as the moon throws light upon the future condition of our own earth. For this reason it may be interesting for the reader to compare

FIG. 4.

with the figures representing the belt of sun-spots seen last summer a picture of Jupiter and his belts, shown in Fig. 4. It is, of course a long step from the string of separate spots in one case to the unbroken bands in the other, and yet it is easily seen that some resemblance

exists, which becomes all the more striking if we believe that Jupiter was once a true sun, which has parted with most of its light and heat, and is approaching the condition of a crusted globe. It would only be necessary to increase the number of sun-spots in order to make a continuous belt around the sun, and, when one such belt was formed, it is likely that there would be another to match it on the other side of the equator, for, as is well known, the regions in which the greatest number of sun-spots appear lie on each side of the solar equator, and any general cause which increased the absolute number of sun-spots would proportionally increase the number seen in the two regions of their greatest frequency.

There are other points of resemblance between the sun and Jupiter which add strength to the suggestion that the sun may now be just entering upon a stage which is the precursor of the gradual loss of its light and heat, and of its approach to the present condition of Jupiter. Careful observation has shown that different portions of the sun rotate in different times, the equatorial region moving faster than any other part, and curiously enough the same peculiarity is seen in Jupiter. This fact came out very clearly through the study of the great red spot which made its appearance in the southern hemisphere of the planet in the summer of 1878, and which has only just now faded out of sight. It was found that the red spot lagged behind the equatorial spots, so that the latter made a complete circuit of the planet, with respect to the red spot, in about forty-four and a half days.

It must not be overlooked, however, that belts of sun-spots, no matter how numerous the spots composing them might be, would bear only a superficial resemblance to the belts of Jupiter, for the latter have a cloud-like appearance, while sun-spots are clearly huge chasms in the photosphere. In fact, a continuous band of sun-spots, as such, could not exist. But in view of the close resemblance between the situation of Jupiter's belts with respect to his equator, and that of the zones of sun-spots with respect to the sun's equator, it is easy to conceive that similar causes may be concerned in the production of both phenomena, the effects varying with the difference in condition of the two bodies. One of these causes, which would probably be operative in both cases, is the rotation of the body acting upon its fluid envelope. Even on the earth we have a zone of winds and violent revolving storms produced in the atmosphere on each side of the equator. On Jupiter, in corresponding latitudes, we see the great belts and spots, whose broken and ever-changing aspect indicates the action of tempestuous forces in the deep and dense atmosphere of that planet of a magnitude incomparably greater than anything of the kind upon the earth. On the sun, still in corresponding latitudes, we have the spot-zones wherein rage solar tornadoes and hurricanes, as far exceeding the storms upon Jupiter as the latter exceed those upon the earth. We see, then, that in three members of the solar system—the Earth,

Jupiter, and the Sun—representing stages of development separated by vast intervals of time, certain regions north and south of their equators are the scene of violent disturbances in their fluid shells or envelopes. But it will not do to liken these phenomena upon the three different globes too closely to one another, for they unquestionably differ not merely in magnitude but in kind and in mode of operation, and this is specially true as to the earth and the sun. We may speak of a sun-spot as a solar cyclone, but we must not forget that it is very different from our West Indian cyclones or East Indian typhoons. The point is that in each case—that of a solidified globe like the earth, surrounded by a comparatively rare atmosphere; that of a partially cooled globe, like Jupiter, enveloped in a dense atmosphere of great depth; and that of a completely gaseous globe like the sun, possessing a sort of shell of partly condensed gases—certain regions near the equator are those in which the greatest disturbance is visible, and in every case, probably, the force of rotation is a powerful factor in the production of these zones of commotion. This shows a sort of survival of the action of certain causes under changed conditions, as a globe proceeds in the process of cooling and condensation from the condition of a sun to that of an unsolidified planet, and so on to the condition of a crusted or solid earth. So, then, we may with some show of reason suggest that the half-belted appearance of the sun last summer was in a certain sense prophetic of its future condition, and that in time its spot-zones will be succeeded by continuous belts resembling those of Jupiter. But no human eye will ever behold the sun thus robbed of his majesty, with his glorious light extinguished by bands of gloomy vapors; for, long before he could reach such a condition, life would cease in the solar system, from want of his vivifying radiations.

The picture of Jupiter here given possesses some interest in itself, as it is a representation of the planet as it appeared in September, 1879, when the celebrated red spot was a very striking object. The spot is seen at the left hand edge of the disk, just above the great southern belt which is narrowed, or indented, in a very singular way, opposite the spot. The red spot is no longer visible, and as it was, perhaps, the most remarkable marking, except the belts themselves, ever seen upon Jupiter, pictures of it will possess great interest in the future.

THE MORALITY OF HAPPINESS.

By THOMAS FOSTER.

I. INTRODUCTORY.

IT is known to all who watch the signs of the times—obvious, indeed, to them, and known to many who are less observant—that those moral restraints which claim to be of sacred origin are no longer accepted by a large and increasing number of persons. I have no wish to inquire here whether those restraints should be regarded as of divine origin or not. I note only the fact that by many they are not so regarded. I am not concerned to ask whether it is well or ill that their authority should be rejected, and their controlling influence be diminishing or disappearing among many; it suffices, so far as my present purpose is concerned, that the fact is so. The question then presents itself, Does any rule of conduct promise to have power now or soon among those who have rejected the regulative system formerly prevalent? We need not consider whether such a rule of conduct, necessarily secular in origin, is in itself better or worse than a rule based on commandments regarded as divine. All we have at present to ask is whether such a regulative system is likely to replace the older one with those over whom that older law no longer has influence.

Here at the outset we find that those who hold extreme views on either side of the questions I have left untouched agree in one view which is, I think, erroneous. On the one hand, those who maintain the divine character of the current creed insist, not only that it is sufficient for all, but that, in the nature of things, no other guide is possible. On the other hand, those who reject the authority of that creed most energetically, assert as positively that no new regulative system, no new controlling agency, is necessary. As Mr. Herbert Spencer has well put it, "both contemplate a vacuum, which one wishes and the other fears." But those who take wiser and more moderate views, who, in the first place, recognize facts as they are, and, in the next, are ready to subordinate their own ideas of what is necessary or best for the ideal man to the necessities of man as he really is, perceive that for the many who no longer value a regulative system which, so far as they are concerned, is decaying, if not dead, another regulative system is essential. Again, to use the words of the great philosopher whose teachings are to be our chief guide in this series of papers, "Few things can happen more disastrous than the decay and death of a regulative system no longer fit" (for those we are considering), "before another and fitter regulative system has grown up to replace it."

My purpose in these papers is to show how rules of conduct may be established on a scientific basis for those who regard the so-called

religious basis as unsound.* I shall follow chiefly the teachings of one who has inculcated in their best and purest form the scientific doctrines of morality, and may be regarded as head, if not founder, of that school of philosophy which, on purely scientific grounds, sets HAPPINESS as the test of duty—the measure of moral obligation. To Mr. Herbert Spencer we owe, I take it, the fullest and clearest answer to the melancholy question, "Is Life Worth Living?" whether asked whiningly, as in the feeble lamentations of such folk as Mr. Mallock, or gloomily and sternly, as in the Promethean groans of Carlyle. The doctrine that happiness is to be sought for one's self (but as a duty to others as well as to self), that the happiness of others is to be sought as a duty (to one's self as well as to them)—happiness as a means, happiness as the chief end—such has been the outcome of the much-maligned philosophy of Mr. Herbert Spencer, such has been the lesson resulting from his pursuance of what he himself describes as his "ultimate purpose, lying behind all proximate purposes," that of "finding for the principles of right and wrong, in conduct at large, a scientific basis."

If I can help to bring this noble and beautiful doctrine—for noble and beautiful even those must admit it to be who deny its truth—before the many who regard Herbert Spencer's teachings with fear and trembling, not knowing what they are, I shall be content. But I would advise all, who have time, to read the words of the master himself. Apart from the great doctrines which they convey, they are delightful reading, clear and simple in language, graceful and dignified in tone, almost as worthy to be studied as examples of force and clearness in exposition as for that which nevertheless constitutes their real value—the pure and beautiful moral doctrines which they offer to those over whom current creeds have lost their influence.

Let me hope that none will be deterred from following this study, by the inviting aspect of the moral rules advanced by the great modern teacher—even as in past times men were anxious, or even angry, when another teacher showed more consideration for human weaknesses than had seemed right to the men of older times. I will not ask here whether doctrines of repellent aspect are likely to be more desirable than those which are more benignantly advanced. It suffices that with many the former now exert no influence, whether they should do so or not. So that, as far as these (for whom I am chiefly writing) are concerned, all must admit the truth of what Mr. Spencer says respecting the benefits to be derived from presenting moral rule under that attractive aspect which it has when undisturbed by superstition and asceticism. To close these introductory remarks by a quotation from the charming pages of his "Data of Ethics":

* I say "so-called," referring rather to the *word* "religious" than to any question concerning the divine origin of current creeds. Strictly speaking, the word religious may be as correctly applied to moral rules based on scientific considerations as to those formulated in company with any of the diverse creeds prevailing among men.

"If a father, sternly enforcing numerous commands, some needful and some needless, adds to his severe control a behavior wholly unsympathetic—if his children have to take their pleasures by stealth, or, when timidly looking up from their play, ever meet a cold glance, or more frequently a frown, his government will inevitably be disliked, if not hated; and the aim will be to evade it as much as possible. Contrariwise, a father who, equally firm in maintaining restraints needful for the well-being of his children, or the well-being of other persons, not only avoids needless restraints, but, giving his sanction to all legitimate gratifications, and providing the means for them, looks on at their gambols with an approving smile, can scarcely fail to gain an influence which, no less efficient for the time being, will also be permanently efficient. The controls of such two fathers symbolize the controls of morality as it is and morality as it should be."

II. CONDUCT AND DUTY.*

Morality relates to those parts of our conduct of which it can be said that they are right or wrong. Under the general subject conduct, then, morality is included as a part. On regarding the word "duty" as implying all that we ought to do and all that we ought to avoid, we may say that duty is a part of conduct. All actions which are not purposeless may be regarded as included under the word "conduct," as well as some which, though purposeless at the time, result from actions originally done with purpose until a fixed habit had been acquired. But only those actions which we consider good or bad are referred to when we speak of duty; and the principles of what we call morality relate only to these.

Here, however, we have already recognized a connection between duty and conduct generally, which should show all who are familiar with scientific methods that morality can not properly be discussed in its scientific aspect without discussing conduct at large. Every student of science knows that, rightly to consider a part, he must consider the whole to which it belongs. In every department of science this general law holds, though it is not always recognized. No scientific subject has ever been properly dealt with until it has been

* I remind the reader that in these papers, as stated in the introductory one, I am following the lines along which Mr. Herbert Spencer has already traced the general doctrine of the morality of happiness. Where his reasoning seems open to objection or too recondite to be quite readily followed, I shall indicate such objections, and my own opinion respecting them, or endeavor to remove such difficulties; but the moral doctrine I am here dealing with is that of which he has been the chief teacher, if he may not be regarded as its only founder. Even if the scientific study of ethics, on principles analogous to those which have made astronomy, geology, and more recently biology, true sciences, has been taken up by others and pursued till new truths have been recognized and perhaps some errors pointed out in his treatment of it, it remains still true that he was the first to indicate the true scientific method, and to show where hitherto it had been departed from even by the founders of the school of philosophy to which he belongs.

considered in its relations to its surroundings as well as separately. Even in matters not usually considered from a scientific stand-point the same law holds. To go no further than our own pages, the writer who is dealing with the question "How to get strong?" would not consider how the arms are to be strengthened without duly considering that the arms are part of the body, their exercise related to the exercise of other portions, their development associated with the development of other limbs, with the action of other parts of the body, with the regimen proper for the whole frame.

It may not by many be regarded as a *fault* of most systems of morality that they overlook the necessary connection between conduct in general and conduct as guided by moral considerations. For many are content to regard moral laws as existing apart from any of the results of experience—whether derived from individual conduct, the conduct of men generally, or conduct as seen among creatures of all orders. With many, morality is looked upon as a whole—the whole duty of man—not as a part of conduct. They even consider that moral obligations must be weakened when their dependence on conduct in general is insisted upon. Moral rules, with them, are right in themselves and of necessity—and whether inculcated by extra-human authority, or enjoined by law, or perceived intuitively, are open neither to inquiry nor objection. Clearly if this were so, morality would not be a fitting subject for the scientific method. Its rules would be determinable apart from the discussion of evidence based on experience, whether observational or experimental. I do not here inquire whether this view is right or wrong. Later on it will fall into my plan to do so. At present I only note that we are considering our subject from the stand-point of those who desire to view morality in its scientific aspect. For them it is essential that, as conduct in general includes conduct depending on duty, the discussion of questions of duty can not be complete or satisfactory unless it is conducted with due reference to the whole of which this subject forms a part.

If any doubt could exist in the mind of the student on this point, it should be removed when he notes that it is impossible to draw any sharply defined line between duty and the rest of conduct not depending on considerations of duty. Not only are those actions which under particular circumstances seem absolutely indifferent found under other circumstances to be right or wrong and *not* indifferent, not only do different persons form different ideas as to what part of conduct is indifferent or otherwise, but one and the same person in different parts of his life finds that he draws different distinctions between conduct in general and conduct to be guided by moral considerations. In the evolution of conduct in a nation, in a town, in a family, or in the individual man, the line separating conduct regarded as indifferent from conduct regarded as right or wrong is ever varying in position—sometimes tending to include among actions indifferent those which had

been judged bad or good, oftener tending to show right or wrong in conduct which had been judged indifferent.

If moral laws, then, are to be established on a scientific basis, it is essential that conduct at large should be carefully considered; and not conduct only as it is seen in man, but as it is seen in animals of every grade. Thus and thus only can the evolution of conduct be rightly studied; by the study of the evolution of conduct only can the scientific distinction between right and wrong be recognized; from and out of this distinction only can moral laws be established for those with whom the authoritative enunciation of such laws has no longer the weight it once had, those who find no other inherent force in moral statutes than they derive as resulting from experience, and who reject as unreasonable all belief in the intuitive recognition of laws of morality.

We proceed, then, to consider the evolution of conduct in the various types of animal life, from the lowest upward to man.—*Knowledge.*

GENIUS AND HEREDITY.

By M. E. CARO,
OF THE INSTITUTE OF FRANCE.

IT has been shown by the researches of Galton, Ribot, and others, that a law of heredity exists, and is applicable to our psychological qualities. Without attempting to deny the operation of this law, it is our intention here, believing that its scope has been considerably magnified, to endeavor to determine its limits in particular directions. With this object, we shall confine our inquiry to two points: Is it according to a good philosophical method to explain by heredity alone all the most complex, most delicate, and most considerable phenomena of human life, when we can, with at least as much probability, bring in other causes which, though they have been much neglected, are very perceptible and even more directly observable? And is it true, as is assumed, that all the exceptions to the law of heredity, even in the intellectual and moral order, are only apparent? We shall speak first of those curious facts concerning intellectual heredity, some of which, and those the most extraordinary ones, can not be accounted for by any assignable cause. Other facts in the category can equally well, perhaps better than by heredity, be explained by reference to the medium, to education, to habit, to the moral and intellectual atmosphere in which the child lives, to the force of the influences to which it is subject, and to the examples that are set before it. We acknowledge that the medium can not afford an explanation of genius and can not create superior faculties; but it furnishes the opportunity for their manifestation, and reveals them where they exist. How many noble and high minds have been extinguished by unfavorable circumstances and hos-

tile mediums! What an important part, on the other hand, may have been played in the expansion of superior minds in certain favored families, by the influence of examples of the most delicate methods of investigation in questions of the natural sciences, by habituation to rigorous methods in the exact sciences! Who could in such cases separate what, in the working of such different influences, is attributable to education and what to heredity?

We must first leave out of the consideration genius, properly so called, which can not be included in any determinate category. At this point we meet the error which has vitiated Mr. Galton's whole work, and which is curiously illustrated in the title itself of his book, "Hereditary Genius." Genius is of all things not a phenomenon of heredity. It is precisely in what is extraordinary and exceptional in it —that is, in its essential quality—that genius escapes all our formulas. It is pre-eminently the abnormal phenomenon, the one that we can not reduce to its elements, or put into a classification, an irreducible formula, the resolution of which recognizes no law within the compass of human knowledge. At this point, certainly, Mr. Galton's lists betray their poverty; and he tries in vain to connect the lines of artists and scientific men with the illustrious genius who all at once bursts out from among them. Even in the musical family of the Bachs, which was distinguished for eight generations and through two centuries, we may count up all the examples of the special musical talent which appeared again and again in each generation; we may review all those gifted persons, the organists, the choir-singers, the choir-leaders, the city musicians, whether they be ancestors, sons, or grandsons; but we can find only one Sebastian Bach. Whence came that particular impulsion, that soaring force, that carried him to the very summit of inspiration? Why is it that he alone of the whole family could compose that marvelous series of preludes, fugues, and oratorios which stand as isolated monuments in the history of the great art? Why were none of the others like him? Mr. Galton's tables do not give us the key to this mystery; they simply reveal a transmission of the musical faculty, a community of aptitudes among the members of this family. But that which was not common to him with the others, that which made Sebastian Bach, is the thing we want explained, and it is precisely this that heredity does not explain. The aptitudes were transmitted like a patrimony, but the grand phenomenon of genius was the property of only one, and was produced but once. It is, then, outside of heredity, for it is unique. The same thoughts might be applied to Beethoven, and with still more force, for the only musical examples in his line were those of his father and grandfather, chapel-masters. Similar instances are abundant. We might cite, among the painters, Raphael, whose father, and Titian, whose sons and brother, were respectable but not illustrious artists. Among great men of science what real relation can exist, in the order of skill and genius, be-

tween Aristotle and his father Nicomachus, court-physician, of whom we hardly know anything; or between Galileo and his father Vicenzo, who wrote on the theory of music; or between Leibnitz and his father, law-professor at Leipsic? In fact, only a single example can be opposed to our criticism, that of the family of the Bernouillis, which was celebrated for the number of mathematicians and physicists whom it produced through several generations. Yet here we have to take notice of the fact that only one of the family, John, was rated by his contemporaries alongside of Newton and Leibnitz on account of his brilliant mathematical discoveries. The others were very distinguished men, but that is a different thing. The genius stands apart.

Still, we can say that in these three orders of the creative art there is something hereditary—not genius, indeed, but a kind of necessary apprenticeship, or perhaps a physiological and mental aptitude tending to determine to certain vocations. In this way we can understand why we meet so many musicians, or painters, or men of science, in the same family. In the case of the painters, for example, there is something that inspiration can not do without, there are a number of primary gifts and technical properties in design or color which are easily transmitted by example and imitation in the father's studio, and are distributed as a common patrimony among the children. Only one of the family will rise to the first rank; but this initiation into his art is indispensable to him as a matter of economy of time and labor, and also to give greater freedom to his inspiration. Macaulay has well said that Homer could never have made himself known to us in the language of a savage tribe, and that Phidias could never have carved his Minerva out of a log with a fish-bone. It is necessary to take account of these favorable circumstances, which in some families help to overcome the first difficulties of the art, and furnish the future genius with convenient instrumentalities with which he can make himself familiar and skillful from his earliest childhood. So the taste for music—that is, an aptitude for measuring time and distinguishing notes—is innate with many children, and is often derived from the father, mother, or other ancestors. If both parents are musicians, all the children will generally have a correct ear; if only one of them is a musician, some of the children may have the taste, while others may not. Likewise, a facility in quickly grasping and handling numerical or algebraic values is indispensable to the operations of the mathematician, and may be remarked as a peculiar gift in certain families, among whom may some time arise one illustrious in the science. These conditions are not essentials of genius, but they are useful to it in helping it to disengage and reveal itself. They are, as it were, the alphabet of his art to the composer, mathematician, or painter; and it is not without advantage that the art has, by means of the example and traditions of the family, become a kind of instinct for the future great man. This explains how it is that great painters, mathematicians, or musicians,

are so frequently produced in families in which the practice of those arts and sciences is familiar. The same aptitude may be shared by several members of the family, who will remain in the secondary rank, while a single one rises above them all. It is the aptitude, not genius, that is hereditary, while Mr. Galton has constantly confounded the two. In the other orders of invention, as in poetry and eloquence, there is nothing inconsistent with a solitary instance of genius being produced in a family that does not seem to have been prepared for it. The preparatory training, the special aptitude, are less necessary in them. It is enough if the national language has reached a degree of clearness and vigor in which it can give perfect expression. Generally, the great writer blossoms out alone. He seems to appear, an unexpected phenomenon, in a succession of modest generations, the uniform course of which he breaks at a blow. Sometimes similar aptitudes may be found among other members of the family, but the fact is without significance or consequences. Bossuet, Pascal, Molière, Voltaire, Jean Jacques Rousseau, Byron, and Goethe, however we may try to account for them, can not be explained by heredity. They are the first and the last in the families that produced them, without any visible transmission of superior gifts. Going back in history, but still keeping to modern times, are not Dante, Milton, and Shakespeare also solitary great ones, who can not be satisfactorily accounted for, either by organic evolution, the intellectual medium, or generation? All those external conditions of genius that have been so often analyzed and described may have prepared for the event and primed for the occasion. The last turn was still wanting, the supreme gift that should be decisive over all the rest, and bring it about that among so many heads in the same family or the same nation, equally predestined by the same concurrence of circumstances, one only should have been chosen, and that the light should have shone upon that elect head only; and we may keep on asking, Why on that head, and not on another? No, to this day the great gift of inspiration in science, poetry, and art has not revealed its secret. Those sovereign minds, precisely by what they possess that is incommunicable, rise high and alone above the flood of generations which precede and follow them, and by reason of this superior side of their nature they do not belong to nature. Those exalted originals in mind who tower above mankind have no fathers and leave no sons in the blood. Notwithstanding Mr. Galton, the least hereditary thing in the world is genius.

M. de Candolle * appears to us to have exactly analyzed the origin and conditions of the kind of mental heredity in a slighter degree that we might represent by the words talent, vocation, and aptitude. While he does not deny the influence of heredity in the development of vocations, especially of scientific vocations, which are the special object of his study, he does not declare it exclusive and decisive. After ma-

* "Histoire des Sciences et des Savants depuis Deux Siècles."

ture examination, he does not believe that there is any special heredity for a particular science, but only admits a transmission of the elementary faculties in a condition of harmony and vigor agreeable to a sound mind. This precious heritage may be applied in several very different ways. A person who has received from his parents a certain degree and a favorable combination of the faculties of attention, memory, judgment, and will, is not destined to be condemned by a kind of fatal heritage to any special kind of work. Generally, a reflexive choice, or the rule of circumstances, rather than a special heredity, determines the use that is made of these faculties; its particular direction is decided by the medium and the family; and the success of the effort is determined by the energetic application of the will. A reservation should doubtless be made in the case of a determined taste for a certain career imposing itself upon a young man when he enters into life; but the facts that such tastes and inclinations are often opposed to paternal habits, and that they may be very different as between brothers, are proofs that they are not hereditary; they are often the products of an active imagination called forth by certain attractions, which it has forged for itself, or of notions suggested by some conversation or some entertaining lecture. Much room, then, is left for circumstances and liberty in the employment of the faculties which one has received. "The man endowed with marked traits of perseverance, attention, and judgment, with no considerable defect in his other faculties, will become a jurist, historian, scholar, chemist, geologist, or physician, according as his will is influenced by a host of circumstances. In each of these occupations he will advance in proportion to his strength, his zeal, and the concentration of his energy upon a single specialty. I have little faith in the necessity of innate and imperious vocations for particular objects. This is not to deny the influence of heredity, but to reduce it to something very general, compatible with the liberty of the individual, and susceptible of being inclined or modified according to ulterior influences, the action of which increases as the child becomes a man." Moreover, even when mental heredity seems to have been effectual, it may be regarded as working in the line of the grand categories of faculties, rather than of special faculties. Thus, it is not uncommon to find two brothers, or father and son, celebrated, one in the natural sciences, the other in historical and social sciences: as, for instance, the two Humboldts; Oersted and his brother the jurist; Hugo de Mohl, the botanist, and his brother Jules de Mohl, the Orientalist; Madame Necker, daughter of the geologist De Saussure; Ampère, scholar and literary man, son of a physicist. If there were a special heredity guiding to a particular science, these examples would be inexplicable, while they are quite natural under the supposition of a transmission of general faculties applicable to all sciences having analogous methods.—*Translated for the Popular Science Monthly from the Revue des Deux Mondes.*

THE REMEDIES OF NATURE.

By FELIX L. OSWALD, M. D.

ENTERIC DISORDERS.

ABOUT a century before the birth of the Emperor Augustus, the most popular physician in Rome was the Grecian philosopher Asclepiades. His system seems to have resembled that of our "movement-cure" doctors. Instead of being stuffed with drugs, his patients were invited to his *palæstra*, a sort of out-door gymnasium or hygienic garden, where they were doctored with gymnastics, wholesome comestibles, and, as some writers assert, with flattery—probably courteous attention to the jeremiads of crapulent senators. At all events, his method proved eminently successful, though we need not doubt that all respectable druggists retailed *canards* about his establishment. He had devised a special course of gymnastics for every disorder of the human organism, and repeatedly declared that he would utterly renounce the claim to the title of a physician if he should ever be sick for a single day. Medicines he rejected on the ground that *they accomplish by violent means what the palæstra-method would effect in an easier way.*

Still, in certain cases, a short, sharp remedy might be preferable to an easy-going one, but unfortunately there is a more serious objection to the use of drugs, viz., the danger of complicating instead of curing the disease. For—1. The diagnosis may fail to establish the true cause of the disorder. No watch-maker would undertake to explain the irregularities of a timepiece by merely listening to a description of the symptoms, and before he can trace the effect to its cause he must minutely inspect the interior mechanism. But a physician is not only generally obliged to content himself with the evidence of the external symptoms, but he has to deal with an apparatus so infinitely more complex than the most intricate chronometer, that, even under normal circumstances, the process of its plainest functions has never been fully explained.*

2. We risk to mistake the suppression of the symptoms for the suppression of the disease. We would try in vain to subdue a conflagration by demolishing the fire-bells, but on exactly the same principle the mediæval drug-mongers attempted to restore the health of their

* "Every organic process is a miracle, that is, in every essential sense an unexplained phenomenon."—LORENZ OKEN.

"He obstinately refused to take medicine. "Doctor," said he, "no physicking. Do not counteract the living principle. Let it alone; leave it the liberty of defending itself; it will do better than your drugs. The watch-maker can not open it, and must, in handling it, grope his way blindfold and at random. For once that he assists and relieves, by dint of torturing it with crooked instruments, he injures it ten times, and at last destroys it."—(Scott's "Life of Napoleon," p. 368.)

patients by attacking the outward symptoms of the disorder. Habitual overeating produced a sick-headache: they applied a blister to the head. Impure blood covered the neck with ulcers: they applied a salve to the neck. The alcohol-vice resulted in a rheumatic affection of the knee-joint: they covered the knee-pan with leeches. They suppressed the alarm-signals of the disease, but, before the patient could really recover, his constitution had to overcome both the malady and the medicine.

3. We risk to confound an appeal for rest with an appeal for active interference, and thus to turn a transient and necessary suspension of an organic function into an actual disease. Numerous *enteric disorders*, or bowel-complaints, are thus artificially developed. The marvelous self-regulating principle of the human organism now and then limits the activity of special organic functions, in order to defray an unusual expenditure of vital energy. The after-dinner lassitude can thus be explained: the process of digestion engrosses the energies of the system. Mental labor retards digestion; a strenuous muscular effort often suspends it entirely for hours together. Fevers, wounds, etc., have an astringent tendency: the potential resources of the organism are engaged in a process of reconstruction. Perspiration is Nature's effort to counteract the influence of an excessive degree of heat, and, when the effect of sun-heat is aggravated by calorific food and superfluous clothing, the work of reducing the temperature of the blood almost monopolizes the energies of the system, while at the same time the diminished demand for animal caloric lessens the influence of a chief stimulus of organic activity. Warm weather, therefore, indisposes to active exercise, and produces a (temporary) tendency to costiveness. That tendency is neither abnormal nor morbid, and to counteract it by dint of drastic drugs means to create, instead of curing, a disease. If a foot-messenger stops at the wayside to tie his shoe-strings, the time thus employed is not wasted. The sudden application of a horsewhip would force him to take as suddenly to his heels, but during his flight he might lose his way, and perhaps his shoes.

With a few exceptions, which we shall presently notice, *chronic constipation* results from the abuse of aperient medicines. A spell of dry, warm weather, sedentary work in an overheated room, a change from summer to winter diet—perhaps a mere temporary abstinence from a wonted dish of aperient food—has diminished the stools of an otherwise healthy child. The simultaneous want of appetite yields to a short fast, but the stringency of the bowels continues, and on the third day the parents administer a laxative. That for the next twenty-four hours the patient feels considerably worse than before does not shake their faith in the value of the drug; the main purpose has been attained—the "bowels move." Properly speaking, that movement is an abnormal convulsion, a reaction against the obtrusion of a drastic poison, which has "cured" the stringency of the bowels as a shower-

bath of vitriol would cure the drowsiness of a tired man. An imaginary evil has yielded to a real evil, and, what is worse, becomes itself soon real enough to confirm the opinion of the drug-worshipers that the patient must be "put under a course of corrective tonics." For very soon the unnatural irritation is followed by an abnormal lassitude, a digestive torpor, attended with symptoms of distress that plainly distinguish it from the original remissness of the bowels. In the eyes of the drug-dupes, however, it is nothing but a relapse of the former complaint, and must be combated with more effective remedies. "Treacle and brimstone, thrice a day," was the verdict of the mediæval Æsculap. "The timely use of our incomparable invigorant will regulate the action of the bowels and impart a generous and speedy impulse to the organic functions of the whole body," says the inventor of the new patent "liver-regulator"—a new combination of "valuable herbs" with the usual basis of alcohol. "A wineglassful every morning." The herbs prove their value by enabling the vender to accommodate his customers on Sunday morning, when common dram-shops are closed, and with an equal disregard of times and seasons the alcoholic principle opens the bowels. The incomparable stimulant admits no such excuses as fatigue or warm weather; the charm works; the regular attacks of a life-endangering poison have to be as regularly repelled. Other symptoms, such as troubled dreams, fretfulness, heart-burn and irregular pulse, seem, indeed, to indicate the approach of a new disease, but that will be met by other drugs, and in the mean while the liver-cure is continued. After the lapse of a few months the patient gets possibly a chance to escape his doom; out-door exercise, the excitement of a pleasant journey, a new residence, a change of diet, encourage the hope that the bowels may be left to their own resources, and the "tonic" is provisionally discontinued. An exceptionally strong constitution may really be able to overcome the after-effects of the drug-disease (for from beginning to end it has been nothing but that), but in a great plurality of cases the event proves that the stimulant has fastened upon the system: constipation, in an aggravated form, returns, and can now be relieved only by the wonted means—"a fact," as the orthodox drug-doctor would not fail to observe, "which should convince idealists that now and then Nature can really not dispense with a little assistance." *

* Two generations ago the abuse of purgative drugs was carried to a degree which undoubtedly shortened the average longevity of many families. Thousands of parents made it a rule (which still has its advocates) to dose their children at the end of every month; and Wieland's practical philosopher not only prescribes a laxative for every fit of ill humor, but answers the sentimental tirades of his wife by sentencing her to a prompt enema:

"Brummt mein Engel wie ein Bär,
'Lise,' sprech ich, 'musst purgiren,'
Rufe dann den Bader her,
Lasse sie recht durch-klystiren."

That assistance has made the fortune of numerous nostrum-mongers and helped our made-dishes to wreck the health of many millions. For, without the interference of a positive poison, dietetic abuses have to be carried to a monstrous excess before they will result in chronic constipation. A slight stringency of the bowels is often simply a transient lassitude of the system, and may be safely left to the remedial resources of Nature. After the third day, however, the disorder demands a change of regimen. A chief objection to our system of cookery is the hygienic tendency of the *essence-mania*, the concentration of nutritive elements. Ours is an age of extracts. We have moral extracts in the form of Bible-House pamphlets; language-extracts in the form of compendious grammars; exercise-extracts under the name of gymnastic curriculums; air-extracts in the shape of oxygen-bladders, and a vast deal of such food-concentrations as Liebig's soup, fruit-jellies, condensed milk, flavoring extracts, and branless flour. But, somehow or other, the old plan seems, after all, the best. In the homes of our forefathers morals were taught by example, and with very respectable results. Six years of grammar-drill in a dead language do not further a student as much as six months of conversation in a living tongue—the concrete beats the abstract. Boat-racing, wood-chopping, and mountain-climbing, are healthier, as well as more pleasant, than gymnastic crank-work; the diverting incidents of out-door sports which the movement-cure doctor tries to eliminate are the very things that give interest and life to exercise. And, for some reasons (not easy to define without the help of such analogies), concentrated nourishment does not agree with the nature of the human organism. The lungs find it easier to derive their oxygen from woodland air than from a ready-made extract, and the stomach, on the whole, prefers to get its nourishment in the form for which its organism was originally adapted. *Want of bulk* makes our food so indigestible. In fruits and berries—probably the staple diet of our instinct-taught ancestors—the percentage of nutritive elements is rather small, but the residue should not be called worthless, since it serves to make the whole more digestible. A large, ripe watermelon contains about three ounces of saccharine elements, which in that combination have a mildly aperient effect, while in the form of glucose-candy they would produce constipation, heartburn, and flatulence. The coarsest bran-bread is the most digestible, and to the palate of an unprejudiced child also far more attractive than the smooth but chalky and insipid starch preparations called baker's bread. Graham-bread and milk, whortleberries, rice-pudding, and stewed prunes, once or twice a week, generally keep the bowels in tolerable order, provided that the general mode of life does not prevent the influence of the natural peptic stimulants. But even in a case of obstinate costiveness few people would resort to drugs after trying the effects of a *legumen-diet*. Beans do not agree with some persons (though the Pythagorean interdict has no hygienic significance), but

one of the three legumens—*beans*, *peas*, and *lentils*—is pretty sure to suit every constitution, and as bowel-regulators their value can hardly be overrated. Taken like medicine at regular intervals of eight hours, and in doses of about a pint and a half, the third or fourth meal of pea-soup (boiled in soft water and flavored with butter and a pinch of chopped onions) will prove as effective as a moderate medicinal aperient; but, while the effect even of a mild cathartic is followed by an astringent reaction, the relief obtained by an aperient regimen is permanent, unless that effect is persistently counteracted by the original cause of the disorder. Fruit, fresh or stewed, ripe grapes, or tamarind-jelly, and frequent draughts of pure cold water, will insure the efficacy of the remedy.

Besides an astringent diet, the chief predisposing causes of constipation are: *warm weather*, *overheated rooms*, *want of exercise*, *sedentary occupations*, *tight garments*, the after-effects of *drastic drugs*, of *malarial fevers*, and sometimes of *self-abuse*. *Parturition* is frequently followed by a protracted period of close stools. In the most obstinate cases of constipation *clysters* are preferable to cathartics, for the reason that the former reach the special seat of the disease, viz., the lower part of the rectum, while the latter begin their work by convulsing the stomach, and, by irritating its sensitive membrane, disqualify it for the proper performance of its function. But injections, even of the simplest kind, should be used only as the last resort, after all the following remedies have proved ineffective:

Mastication.—Thoroughly masticate and insalivate each morsel of solid food. Eat slowly; do not soak your bread, etc., to facilitate deglutition, but let the saliva perform that business. The stomach of bilious dyspeptics often rejects a stirabout of bread and milk, but accepts the ingredients in a separate form.

Passive Exercise.—Kneading the abdomen, or riding on horseback or in a jolting cart, often affords relief by dislodging the obdurated obstructions of the lower intestines.

Cold sponge-baths excite a peristaltic movement of the colon, and often induce a direct evacuation.

Air-baths have an analogous effect, and in summer the bed should be removed to the airiest room in the house. After the stools have become more regular, exhausting fatigues (in warm weather especially) should be carefully avoided. The advent of winter greatly lessens the danger of a relapse. Frost is a peptic stimulant, and after October the cold ablutions can be gradually discontinued. Fresh air, an occasional sleigh-ride, or an excursion on a rumbling freight-train, will do the rest; and the cure is complete if, during the next warm season, the digestive organs perform their proper functions without the aid of artificial stimulants. The remedies for bilious constipation have been mentioned in the chapter on "Dyspepsia," but I will here repeat the chief rule for the cure of chronic indigestion: "Never eat till you

have leisure to digest." Avoid after-dinner work; break through every rule of conventional customs, and postpone the principal meal to the end of the day, rather than let the marasmus of the digestive organs reach a degree that calls for a change of climate and occupation, as the only alternative of a total collapse. Open your bedroom-windows, take a liberal dose of fresh spring-water with the last meal, and an air-bath before going to bed, and the result will convince you that night is *not* an unpropitious time for digestion.

Unlike constipation, *diarrhœa*, even in its transient phases, is always a morbid symptom, and a proof that either the quality or the excessive quantity of the ingested food calls for abnormal means of evacuation. For the incipient stages of the disorder the great specific is *fasting*. Denutrition, or the temporary deprivation of food, exercises an astringent influence, as part of its general *conservative* effect. The organism, stinted in the supply of its vital resources, soon begins to curtail its current expenditure. The movements of the respiratory process decrease; the temperature of the body sinks, the secretion of bile and uric acid is diminished, and before long the retrenchments of the assimilative process react on the functions of the intestinal organs; the colon contracts, and the smaller intestines retain all but the most irritating ingesta.*

When that remedy fails, the presumption is that either some virulent substance resists the eliminative efforts of Nature, or else that, in spite of the diminished sources of supply, the accumulated alimentary material still exceeds the needs of the organism. In the latter case, unless a continuation of the fast should seem preferable, the waste can be stopped by *active exercise*. After a hard day's work a man can assimilate a quantum of food that would afflict an idler with grievous crapulence. The Kamtchatka savage has earned the right to digest the flesh of the brute which he has slain in a rough-and-tumble combat. The stomach of the negro does not reject the fruit which he has plucked from the top branches of a tall forest-tree. Loose bowels become retentive if Epicurus has chopped his own wood and fetched his own cooking-water. But the best of all astringent exercises is a *pedestrian excursion*. A liberal supply of green fruit has a laxative tendency. A campaign in an orchard country costs the invaders a good deal of laudanum; in midsummer some forty per cent of the rank and file are generally on the sick-list with diarrhœa. But the first forced march stops such symptoms. Laxatives and pedestrianism are what lecturers on materia medica call "incompatibles." By a combination of foot-journeys and abstinence even a malignant case of chronic diar-

* A persistent *hunger-cure* will eliminate even an active virus by a gradual molecular catalysis and displacement of the inorganic elements. The Arabs cure syphilis by quarantines *à la Tanner*; and Dr. C. E. Page mentions the case of a far-gone consumptive who starved the tubercles out of his system. Aneurisms (internal tumors) have been cured by similar means.

rhœa can soon be brought under control, though the debility of the patient should limit his first excursions to the precincts of his bedroom. Care should, however, be taken not to abuse the partially restored vigor of the digestive organs, especially *during the period of deficient appetite* that often follows a colliquative condition of the bowels. Progressive doses of out-door exercise will gradually overcome that apathy, and, when the stomach volunteers to announce the need of nourishment, it can be relied upon to find ways and means to utilize it.

But the problem of a complete cure becomes more complicated if the bowels have been tortured with astringent drugs. Diarrhœa itself is an asthenic condition, indicating a deficiency of vital strength, yet nearly every health-exhausting poison of the vegetable and mineral kingdom has been employed to paralyze the activity and, as it were, silence the protest of the rebellious organs. Bismuth, arsenic, calomel, opium, mercury, nux vomica, zinc salts, acetate of lead, and nitrate of silver, are among the gentle "aids to Nature" that have been employed to control the revolt of the mutinous bowels. An attempt to control a fit of vomiting by choking the neck of the patient would be an analogous mistake. The prescription operates as long as the vitality of the bowels is absolutely paralyzed by the virulence of the drug, but the first return of functional energy will be used to eject the poison. That new protest is silenced by the same argument; for a while the exhaustion of the whole system is mistaken for a sign of submission, till a fresh revolt calls for a repetition of the coercive measures. In the mean time the organism suffers under a compound system of starvation; the humors are surcharged with virulent matter, the whole digestive apparatus withdraws its aid from the needs of the vital economy, and the flame of life feeds on the store of tissue; the patient wastes more rapidly than an un-poisoned person would on an air-and-water diet. In garrets, where the last piece of furniture had been sold to defray the costs of a direful nostrum, I have more than once seen victims of astringent poisons in a state of misery which human beings can reach by no other road: worn out, corpse-colored, emaciated wretches, with that look of listless despair which the eyes of a dying beast sometimes assume on the brink of Nirvana. The first condition of recovery is the peremptory *abolition of the poison-outrage.* For the first three days prescribe nothing but *sweetened rice-water,* and only tablespoonful doses of that; give the stomach a sorely-needed chance of rest. On the fourth and fifth day add a few drops of *milk,* and toward the end of the week inspissate the broth to the consistency of gruel. There are persons with whom milk disagrees in all its forms; for such prepare a surrogate of *whipped eggs* with sugar and warm water—a tablespoonful every half-hour. Do not hope that the stomach of a far-gone drug-martyr will at once tolerate even such feather-weight burdens; it will not repel them with the spasmodic violence that characterized its reactions against a virulent nostrum,

but it will often protest its disability to retain the whole quantum. A small but increasing percentage will be assimilated, and, if the corresponding enlargement of the rations is not overdone, the patient, at the end of the third or fourth week, may be rewarded by the return of something like positive appetite, i. e., a craving for more solid food. Try a slice of rice-pudding and fruit-jelly, or a homœopathic dose of blanc-mange. Try a soft-boiled egg or a baked apple. Eschew cordials. Avoid food-extracts, even strong beef-tea, which for a person in such circumstances is a stimulant rather than a nourishment. In the mean time watch the weather, and on the first clear day screen the lower windows, open the upper sashes, and treat the patient to a *sun-bath*. Sunlight, applied for half an hour to the bare skin, is a better tonic than cold water, which invigorates a healthy man, but exhausts an asthenic invalid. In the form of *tepid sponge-baths*, however, water should be applied as soon as the patient can bear the fatigue of keeping on his legs for a couple of minutes. The first decided gain in strength employ in the preparatory exercises of *pedestrianism*. Carpet the room, clear a track for a circular walk, provide supports at proper intervals, a small table in one corner, a chair or a curtain-strap in the other. Interest the patient in his progressive achievements, keep a record-book, procure a boxful of chips and tally off each round. Three miles a day mark the time when the sanitarium can be transferred to the out-door world. In a vineyard country devote the vintage season to a three weeks' *grape-cure*. The cure consists in dining on bucketfuls of ripe grapes and transparent slices of wheat bread. Grape-breakfasts, grape-luncheons, and grape-suppers, *ad libitum*, but no bread, nor anything else that could interfere with the system-renovating effect of the sweet abstersive, that has been tried with signal success in the treatment of bilious dyspepsia, gout, and cutaneous diseases.* Extreme caution in the use of animal food, acids, and fermented beverages, for the first six months at least, is as necessary as after an attack of *dysentery*, which should be similarly treated, except that a more rapid recovery of strength will permit a speedier return to out-door and active exercise.

Colic can generally be traced to the presence of fermenting fluids, and is the penalty of excessive indulgence in such beverages as mush, new beer, fresh cider, together with sour milk and watery vegetables, but may in rarer cases indicate the agency of more dangerous substances,

* The grape-cures of Thionville, Staremberg, Meran, Lintz, and the Bergstrasse, near Mannheim, are yearly visited by thousands. In the United States the best facilities might be found at Hammondsport, Flushing, and Iona Island, New York; Salem, Massachusetts; Hagerstown, Maryland; Lebanon, Columbia, and Eagleville, Pennsylvania; Golconda, Illinois; Hermann, Missouri; Cincinnati, Delaware, and Kelly's Island, Ohio. All Southern California is now studded with vineyards, and the *Trauben-kur* of Meran hardly excels the grapes of San Gabriel and Annaheim. Five cents a pound for the ripest bunches is the average price on Kelly's Island; in California from two to three cents a pound; in larger quantities perhaps even less.

drastic mineral acids, putrefactive and zymotic poisons, noxious gases, etc. Rest and warm bandages are the best remedies. The antidotes of *corrosive poisons* will be named in a separate chapter. The pains of *gastric spasms*, as a consequence of dietetic sins, may be alleviated by manipulation and friction with a moist piece of flannel; in extreme cases, indicating the presence of virulent acids, by means of a stomach-pump. Generally a semi-horizontal position, reclining on the left side, with the upper part of the body slightly raised, together with local friction, will considerably ease the distressed organ, though intermittent griping pangs may continue till the alchemy of the physiological workshop has neutralized the irritating substance. From a kindred affection colic can be distinguished by a simple test: if pressure against the upper part of the groin increases the pain, the complaint is an inflammation of the peritonæum, but otherwise due to the presence of acid fluids or expansive gases. *Painter's colic* may be recognized by the discoloration of the gums and lips, and can be cured only by the removal of the cause. A napkin, sprinkled with aromatic vinegar, and tied loosely across the nostrils, will, however, lessen the effect of the noxious effluvia; and the Italians recommend the internal use of olive-oil (cotton-seed oil would probably serve the same purpose) and wine. For a few days after a severe attack of colic, pure water should be the only drink.

Flatulence tends to obviate the proximate cause of intestinal cramps. As a concomitant of dyspepsia, it indicates the accumulation of undigested food and the necessity of greater abstemiousness. Burnt magnesia absorbs gastric acids, but at the same time impairs the functional vigor of the stomach too often to be, on the whole, a lesser evil. It is, however, one of the very few chemical remedies which act, temporarily at least, by a direct removal of the proximate cause. Its permanent removal can be effected only by a change of regimen.

In the treatment of *hæmorrhoids*, too, we have to distinguish between palliatives and radical remedies. If the statistics of the complaint could be tabulated, I believe it would be found that its centers of distribution coincide with a prevalence of sedentary occupations, combined with the use of narcotic drinks, especially coffee. Monkeys have posterior callosities, and their habits prove that an occasional sitting posture is normal to the primates of the animal kingdom. But, in a state of nature at least, our arboreal relatives are too restless to avail themselves of their sitting facilities oftener than five or six times a day —for about a minute at a time. In menageries they become sedate enough for ten-minutes sessions. But a German chancery-clerk has to sit fifteen hours a day, awaiting promotion and the supper-hour, for he is often required to eat his dinner *in situ*. If his dinner-basket is sent from a cheap boarding-house, it is sure to contain a selection of highly astringent comestibles—tough beef, leathery potato-chips, all-spice, ginger-cakes, and pickles. The accompanying flask contains

coffee. If the man of sessions stoops, he damages his lungs; if he leans against the edge of the table, he may endanger his stomach; but, as sure as he sits, he compresses the region of the *vena portæ*. Obstructions of that vein are favored by two circumstances: it has to pass a double system of capillaries, and, before it can reach the liver, it has to pump its heavy blood *upward*. Sooner or later the incessant pressure results in varicose enlargements, actual obstruction occurs, the vein-bags become engorged and at last inflamed, and their rupture discharges the blood, which mingles with the secretions of the rectum, and causes that incessant pricking and burning that make hæmorrhoids (emerods, piles) as troublesome as a combination of itch and gout. An astringent diet aggravates the evil by inspissating the blood and retarding the process of circulation. The stricken Philistines obtained relief by sacrificing golden *fac-similes* of the afflicted parts, and cauterizations temporarily free the obstructed passages; but the days of miracles are past, and, as long as the cause continues to operate, it would not avail the patient to sacrifice his entire stock of emerods. *Inunctions of warm tallow* will palliate the itch. Common mutton-tallow serves that purpose as well as any patent ointment, for itch and its cognate complaints are not amenable to the influence of the faith-cure. The radical remedies are *gymnastics* and an *aperient diet*. The gymnastic specifics are the exercises that promote deep and full respiration, and at the same time react on the abdominal cavity, as spear-throwing, swinging by the arms, and dumb-bell practice. The diet should be digestible, and as fluid as possible; while exercise stimulates the circulation, the diluents will attenuate the blood, and thus obviate the proximate cause of the disorder. If the patient has to stick to his office, he should procure a combination-desk (which any carpenter can construct without infringement of patents), and stand and sit by turns.

The ancients kept slaves who had to work all day, sitting before a primitive grist-mill, and it is possible that hæmorrhoids are really a very antique complaint. But during the age of gymnastics and unfrequent meals it is not probable that people suffered much from *maw-worms*. Parasites are marvelous colonizers. Wherever the ground is prepared for their reception, the seed is sure to make its appearance. There are about sixty different kinds of mildew, a special variety for nearly every special kind of fruit or vegetable; and, if a decaying berry of the rarest sort is exposed to the open air, it will soon be covered with its specific kind of mold. A piece of putrid flesh will attract blow-flies, even where flies of that sort have never been seen before. The germs of numberless parasites fill the air, and each species, after its kind, will promptly fasten upon every sort of decaying or stagnant organic matter, even in the interior of the body. But in the living organism of the human system such stagnations are wholly abnormal. In the economy of the digestive organs peptic disintegration should

precede putrefactive decay; the chyle should never stagnate, the stream of the organic functions should move with an uninterrupted current. There are rivers that become so low in summer that pools of water can be found only in the deeper cavities of the river-bed, and such pools are sure to swarm with "wrigglers," or incipient gnats. But, as soon as the current of the rising river drains those pools, the wrigglers speedily vanish.

The maw-worm plague is caused and should be cured on the same principle. Most people eat too often. Before the stomach can dispose of the first meal, it receives a second consignment, and soon after a third, of comestibles elaborately contrived to retard digestion; afternoon work monopolizes the energies of the system; the *mélange* in the small intestines becomes unmanageable, stagnates, and at last ferments. Babies are gorged with milk till the contents of the little vessel literally spill at the muzzle; they are swaddled and bandaged, kept in horizontal confinement, and anxiously prevented from every motion that might ease the labor of the sorely overtaxed bowels. Fresh air, the next best peptic stimulant, is likewise carefully excluded. Nature fights the enemy for a week or two, but at last succumbs to odds: fermentation sets in; parasites fasten upon their well-prepared pabulum, and soon the tortures of the mummified little martyr are aggravated by the wriggling of hundreds of ascarides. Nervous children can thus be worried into epileptic fits, and even delirium and brain-fever. Locally the worm-plague produces constipation, hæmorrhages (often resembling the symptoms of true hæmorrhoids), and burning stools.

If the evil has reached proportions that defy dietetic specifics, the removal of the cause (as in prurigo, scabies, and syphilis) requires the application of artificial remedies. Injections of warm water with an infusion of *quassia*, or *carbolic acid*, will expel pin-worm; *oil of chenopodium* (worm-seed) in minute doses, administered with a teaspoonful of castor-oil, is an effective prescription for the expulsion of the "round-worm."

Among the remedies against *tæniæ*, or tape-worms, the following vegetable specifics are not less effective and much safer than the *calomel* preparations which were formerly prescribed for that purpose: Pomegranate-bark (*Granati fructus cortex*); male fern (*Filix mascula*); but especially *pounded pumpkin-seed*. Three ounces of the fresh seed, mixed with a pint of water and pounded into an emulsion, taken after a twenty-four hours' fast, rarely fail to evict the tenant within three hours.

But the germs of the parasites remain behind, and the same predisposing conditions may at any time effect their redevelopment. Dietetic remedies must complete the cure. Children should be restricted to three meals a day. Let them earn their recovery by exercise—running, tumbling, dangling at the end of a grapple-swing. Adults should

limit themselves to a lunch and a good dinner, drink a liberal quantum of fresh, cold spring-water, but no fermented beverage, and strictly abstain from indigestible food, especially cheese, sour rye-bread, sauer-kraut, archaic sausages, pickles, and hard-boiled eggs. Light bread, cream, and grapes (or baked apples), should constitute the staple of the diet. A two-weeks grape-cure can do harm. An occasional fast-day will insure the elimination of undigested food-deposits. Pin-worms that have escaped the day of wrath may now and then betray their presence, but they have ceased to multiply, and, after the current of the organic circulation has once been fairly re-established, intestinal parasites will disappear like the wrigglers of a drained river-pool.

LAND-BIRDS IN MID-OCEAN.

By GEORGE W. GRIM.

THE appearance of some of the smaller varieties of migratory birds, such as sparrows, swallows, doves, etc., several hundred miles away from the nearest land is by no means an unusual occurrence on the ocean. About these little erratic visitors there are some curious and interesting facts. Their appearance is almost always one at a time, though I have known a considerable number, representing, perhaps, as many different varieties, to accumulate in the course of a day. It is usually, though not always, in stormy or unsettled weather.

The first curious fact about these birds is, that they never appear to be tired out; whereas birds are often met with near the land with their strength quite exhausted. A second curious fact about them is their preternatural tameness where there is no cat or dog on board, and the crew show no disposition to molest them, as exhibited by their apparently seeking rather than avoiding the presence of man.

Another curious fact about them is the recovery of all their native wildness and their instinctive avoidance of man's presence on approaching the land. The first time I noticed this fact was with a pair of olive-colored ring-doves, which, from their remarkable tameness and familiarity, I was led to believe had been bred in a domestic state and perhaps on shipboard. I kept them in the skylight in the cabin, where they seemed to be quite contented; but on approaching the land they became the wildest of the wild. One of them escaped and flew away. I succeeded in taking the other into port, where I gave it its liberty. Now, I am certain that these birds could not have been apprised of the approach to the land through the medium of any of their ordinary senses. This curious circumstance led me to notice more particularly the conduct of other varieties of these little

wanderers upon the ocean so far from their native habitat, and I find that they nearly all exhibit to a greater or less extent the same curious characteristics. Here the observant mariner with a smattering of science may find something to cogitate upon.

Light, heat, sound, etc., are said to be effects produced upon the living organism through the medium of appropriately developed organs by as many different modes of motion, whereby the animal is brought into conscious connection with surrounding objects, the effect diminishing in a progressive ratio as the distance of the object increases. Of these special organs there are said to be five in number which are essential to the well-being of all perfectly developed animals. But may there not be other analogous modes of motion, producing analogous effects upon the living organism, whereby the animal is brought into conscious connection with surrounding objects, and by or through which it has a sense of the locality or direction of such objects as are essential to its well-being to seek or avoid? Admitting this, suppose a flock of birds have started on one of their migratory excursions, guided mainly by this sense of direction, in pursuit of some distant object. Then let us suppose that in their flight they pass obliquely, but unwittingly, into another higher stratum or current of air moving with great velocity in some other direction, but toward the ocean. The flock would necessarily become very much scattered, and in the confusion a portion of them would be carried unconsciously out to sea, beyond the range of their sense of direction—having lost which, they fly at random and at ease, exerting just sufficient effort to sustain themselves in the air; while another portion of the flock, keeping within the limit of their sense of direction, will exhaust all their strength vainly endeavoring to reach their object against a violent wind.

So intimately associated with this sense of direction is their instinct of self-preservation in avoiding the presence of man, that while the one is in abeyance, the other, in the absence of anything to arouse it, remains dormant. This, I believe, is the true meaning of the preternatural tameness exhibited by the birds on the Galapagos Islands mentioned by Darwin.

From the peculiar properties of air in its relation to heat, the atmosphere has a tendency to form itself into heterogeneous strata, more or less inclined to the horizon; each stratum having a horizontal motion independent of the others—a fact the significance of which, I think, is frequently lost sight of by meteorologists, more especially by cyclonologists. That some of the higher strata of the atmosphere have an independent horizontal motion, the velocity of which is often incomparably greater than anything we experience in the lower stratum, is evident not only from the appearance in mid-ocean of birds, but of insects hundreds of miles from land, and apparently as lively as if they were in their own native haunts. I have seen grasshoppers at

least a thousand miles,* and dragon-flies certainly two hundred miles from land.† During a recent voyage from New Zealand to New South Wales, and thence to Japan, frequently, for several days in succession, moths and butterflies were visible in the air nearly every hour in the day.

THE ILLUSION OF CHANCE.

By WILLIAM A. EDDY.

STUDY of the movements of events reveals dynamical, necessary sequences, and contemplation of the laws of probability, treated mathematically, generally involves a mental attitude at variance with theories of luck and premonition. It is believed that a rational treatment of the question will help to dispel superstitious ideas by disclosing the chain of continuity in all known actions. First, we will consider events mathematically, or as illustrating the laws of probability; and, second, as related to the practical question of success in life. The subject includes indirectly the question of ethics. Wrong or injurious action seems to disappear into a vast labyrinth. As we judge superficially or by immediate effects, we are easily misled into a belief that fraud may result in permanent gain, or that oppression will cure some political evils. It is important, for instance, that we have right ideas regarding the tendency in affairs whereby continued injustice or abuse of power comes to retribution. The jarring of the just relations of things leads to complications too subtile to be controlled, as the tyrants of history found by terrible experience, and the fact that our control is partial, as noticed definitely further on, should cause fear of the improper use of power. These truths well justify an examination of the subject.

Before considering the more complicated question of partial control in its relation to success, we will first glance at the simple or direct relations between familiar events, as seen in the calculable uniformity in the average results of great numbers of so-called games of chance. The numerical results of card-playing and dice-throwing, as examined by Professor Venn, have reaffirmed what is generally known

* "December 13, 1876, latitude 17° 24′ north, longitude 44° 12′ west. While taking the sun at noon, noticed a number of grasshoppers about the vessel. Made several unsuccessful attempts to capture one of them. The nearest point of land is the Island of Montserrat, latitude 16° 48′ north, longitude 62° 12′ west, distant 1,023 miles."—(Extract from a private log.)

† In the vicinity of the river La Plata, violent westerly gales, called *pamperos*, are of frequent occurrence. One of the surest precursors of these gales is the appearance of numerous dragon-flies in the air. I have seen these insects collecting about the ship fully two hundred miles from land, off the entrance of the river, while the wind was still blowing a gale from the eastward.

—that resulting special aggregates, differing widely in number, show a narrow margin of difference when combined into an average of many such aggregates. "Let us suppose," he says, "that we toss up a penny a great many times; the results of the successive throws may be said to form a series. The separate throws of this series seem to occur in utter disorder. . . . But when we consider the result of a long succession we find a marked distinction; a kind of order begins gradually to emerge, and at last assumes a distinct and striking aspect."*

It is claimed that at one time about two hundred persons committed suicide annually in London, but it is possible that the increase of prosperity or the extension of moral influence might lessen the number. Human actions, when compared with games in which no skill is applied, thus disclose a marked difference in the fact that the average of many games shows a very small margin of departure from calculated uniformity, while during long periods human actions arising from like causes differ widely, owing to the evolution of intelligence, which gradually establishes extensive differences. Many natural phenomena go through long periods of growth and decline. But this method in nature may be far more difficult to trace than that in a game of cards. It is completely beyond our power to arrange the star systems in even a theoretical way that would seem in the slightest degree complete. In phenomena repeated at conceivable intervals, however, we may find the average as steadily maintained as that of great numbers of games. This is seen in the slight variations in the average of rainfall during a decade. If we extend the problem beyond the range of our short lives, we again find that apparently fixed averages slowly change. It would, therefore, require inconceivable lapses of time to discern the uniformity of average in these gradual changes during many centuries. As an illustration of this, there are good reasons for believing that the temperatures of the north and south temperate zones vary so greatly in ten thousand five hundred years that large portions of the globe now under cultivation will be covered by glaciers. Mr. H. B. Norton, in a lecture delivered before the Kansas Academy of Science,† makes a careful mathematical calculation based on the precession of the equinoxes. He thus estimates that the greatest variation in length between winters of the northern and southern hemispheres occurs at recurring periods of twenty thousand nine hundred and thirty-seven years. These great lapses of time are, he claims, accompanied by alternate deep submergence of the poles in accordance with the gradual change of the earth's axial inclination. He says:

"It thus appears probable that there have been many glacial periods in each hemisphere, and that the ocean, like a mighty pendulum, vibrates from pole to pole."

* "The Logic of Chance," by John Venn, M. A., p. 5.

† Published in "The Popular Science Monthly," October, 1879.

Herbert Spencer points out similar truths in that part of his philosophy concerning the rhythm of motion:* "Every planet, during a certain long period, presents more of its northern than of its southern hemisphere to the sun at the time of its nearest approach to him; and then, again, during a like period, presents more of its southern hemisphere than of its northern—a recurring coincidence which, though causing in some planets no sensible alterations of climate, involves in the case of the earth an epoch of twenty-one thousand years, during which each hemisphere goes through a cycle of temperate seasons, and seasons that are extreme in their heat and cold. Nor is this all. There is even a variation of this variation. For the summers and winters of the whole earth become more or less strongly contrasted, as the eccentricity of its orbit increases and decreases. . . . So that in the quantity of light and heat which any portion of the earth receives from the sun, there goes on a quadruple rhythm, that of day and night; that of summer and winter; that due to the changing position of the axis at perihelion and aphelion, taking twenty-one thousand years to complete; and that involved by the variation of the orbit's eccentricity, gone through in millions of years."

These phenomena illustrate the regularity of averages on an immense scale. The differences in temperature between unusually hot or cold seasons in a given year all offset one another when reduced to an average of a decade or of a century, just as we assume that the great differences between glacial and tropical temperatures manifest approximate uniformity in the long period above considered. It is thus clear that circumstances or the motions of events lead to sustained average results in spite of seeming irregularities. The slowness with which some great changes take place is equivalent to the establishment of permanent conditions as far as the short duration of our individual consciousness is concerned. The glacial period, whether due to the precession of the equinoxes or some other cause, involves a lapse of time far longer than is covered by the historical record of the earliest races, along down the line of mingled civilization and barbarity to the present time.

In deference to those who are too cautious to accept any doctrine of averages in nature, it is well to give full weight to an opinion in a letter from Professor C. H. Hitchcock, regarding the glacial period. He thinks that every agency must be considered, including "obliquity of orbit, precession of the equinoxes, axial variation, and elevated planes at the north." He adds, "If you can prove that in an ice age at the north the climate about the south pole was ameliorated, then the fact that it is somewhat colder there now may be of service." Beside the variation in ocean-level, we may consider it probable that, when the earth cooled from its primeval molten state, it was left with

* "First Principles," pp. 256, 257.

slight excess of elevated surface at points either north or south of the equator, and that in time this resulted in difference of temperature, in ice accumulation, in axial variation due to unequal attraction. Professor Hitchcock's suggestion of many causes is valuable because it calls attention to the possibility or probability of a vast and connected ring of variations, each related to the other, so that ultimately we can only understand the facts as illustrating the instability of the homogeneous as taught by Herbert Spencer. But the oscillation is manifested in so many other ways that, even when it fails as applied to a special series of geological facts, we are still justified in believing it as an underlying truth not demonstrated in this case, owing to our want of definite knowledge concerning the glacial period.

Having thus glanced at mathematical considerations, we now pass to the identity pervading widely different phenomena. In addition to this law by which exceptional events are found to accord with a certain average, we further find identity in various kinds of action. When the ice on the river is rent with a sound like the booming of cannon, we detect some resemblance to the rumbling of an earthquake. Hence the theory may be that the subterranean sound involves the cracking of rocky strata. The motion of a small whirlpool, of a tornado, of the solar system, and hypothetically of great extents of nebulous matter, discloses an undercurrent of identity indicating that we should not value the event in itself, but the wide play of phenomena so represented. We may further conclude that the material universe, as far as known, is of value as standing for something beside optical appearances and mechanism. Aside from this representative value, concerning sidereal systems, men of genius may discern direct practical power in small things, as in the following instances: Watt applies to a wider use the lifting power of steam, as seen in the upward motion of a tea-kettle cover,* and Edison applies the lessened friction between electrified metal and rough paper to the general purpose of reducing the friction of machinery—at present this principle is used to increase the sounding power of the telephone. Many things appear trifling because we fail to see in them the wonderful analogies awaiting disclosure and the possibilities of development, so that lack of perception or combining power is the main condition of our helplessness in the presence of many forms of material action or phenomena.

In direct opposition to the idea of mastery through knowledge and continuous effort, we find the belief in luck, the central idea of which is that a bias in our favor may pervade events. The notion of natural order in events, followed regardless of persons, substitutes for the illusion of luck the truth of a mere coincidence between what we like and what results. Such favorable coincidences when not read aright have wrecked the lives of some men who might otherwise have developed useful powers. A careful study of such a fortunate turn of events

* The story has been discredited, but the truth is applicable.

reveals some unpleasant but irresistible facts—that a sustained favorable coincidence is very rare and likely to be of doubtful permanent value, because there is not a proper development of personal quality whereby no injury will result from prosperity. The fortunate person tries to swim in a sea of new conditions which he has not reached by a natural process of growth. The phrase "always lucky" is open to two objections not easily set aside, owing to the profound complexity of events: that the person may have skill, tact, agreeableness; and that there may be error, owing to the special or restricted view of the person judging. Belief in luck is directly and practically objectionable, because it leads to submission in matters requiring action.

Another singular but essentially superstitious idea at times gains credence. A connection between two events is affirmed strongly in proportion to lack of evidence, or it is assumed that an event has necessary relation to personal welfare. This was well illustrated by an occurrence in the central part of Illinois during the presidential contest between Lincoln and Douglas. Two flag-staffs, about two hundred feet high, had been put up in the Court-House Square of the town. Just before the election the staff in honor of Douglas fell, owing to a defect in the timber. It was at once thought that this foreshadowed the defeat of Douglas, and when the result seemed to verify this prophecy the superstitious impression became stronger than ever.

Our tendency to fill the unknown with imposing possibilities is a natural and perhaps justifiable effect of the profound mysteries of life and being which stimulate our curiosity and imagination, but there is absurdity in postulating connections between special events which are much better explained by means of the usual physical factors and the reason. With some persons the supposed relation between death and thirteen at table seems impressive, because it is assumed that there is interference owing to unknown laws of action or association. It may seem incredible that any well-educated person should hold this belief seriously, yet beyond the shadow of a doubt it has influenced many who were able in action, if not in dealing with questions of causation. As death and thirteen at table are both quite common, it follows that the concentration of attention upon this or any usual number must result in the observation of many coincidences. An absence of the coincidence is easily overlooked, because the allowance of one year for the death to occur causes the prophecy to be forgotten. The disclosure of this or any other causal connection at once deprives the superstitious idea of its assumed value. This is evident in a like instance if we maintain that spilling salt has relation to calamity because it indicates carelessness and nervousness. Nature never overlooks carelessness, and nervousness may arise from consciousness of impending trouble; hence statistics might show (if we could eliminate other influences) that persons who spill salt or upset things are more liable to disaster

than others. The rejection of a natural cause is unfortunate, because it is one form of the belief that an imagined relation is objective. It is assuming that an event will necessarily conform to a prophecy made entirely without reasonable data. George Eliot pointed out this absence of reason by saying, in effect, that some people are surprised at the presence of an evil which they have done everything to produce, and at the absence of a wished-for result which they have done nothing to attain.

FEMALE EDUCATION FROM A MEDICAL POINT OF VIEW.*

By T. S. CLOUSTON, M. D.

THERE are a good many reasons why physicians should have opinions about the education of youth rather different from those held by most of the public and of the professional educators. Their whole art is founded on the study of the human being—his beginning, his development, his course, his decay, and his death. All his structures and all his functions are carefully inquired into. A doctor must nowadays be a physiologist, and a physiologist includes the mental as well as the bodily functions of man in his range of inquiry. In fact, it is one of the peculiarities of the physiological mode of studying human nature that man is looked on as a whole—body and mind together—a unity, in which they can not be studied apart from each other. Then the practical aims of modern medicine, founded on this enlarged study of man, are getting to be more and more concentrated on measures for the prevention of diseases, and not merely for their cure. To prevent disease one must control the conditions of life. Especially in youth, when the human being is most amenable to influences for good and evil that affect the whole future life, must one regulate the conditions of life, if health is to be preserved. The doctor finds that health means far more than a good digestion. It means a conscious sense of well-being all over, contentment, power of work, capacity to resist evil influences, and, to some extent, good morality. It means a sound mind in a sound body. The process and the method of education undoubtedly influence health strongly. If the educator has damaged the health, the doctor is expected to put it right. An important part of the physician's duty is to study the sum-total of a man's hereditary tendencies, and his bodily weak or strong points, what is commonly called his constitution. He finds that education in many of its modern forms may be either a most helpful or a most dangerous process to many constitutions. In fact, the modern physician is rather

* Lecture delivered at the Philosophical Institution of Edinburgh, November, 1882.

disposed to set up as the skilled engineer of the human machine, and the authoritative exponent of its proper treatment in all its departments, both when it is working rightly as well as when it goes wrong.

A careful study of the qualities and capacities of one's material is the very first thing to be done before determining the wear and tear to which it is to be subjected, or arranging the work it is to do. This is a comparatively easy matter, when an ordinary machine is to be made, however complicated. The iron and the steel of the locomotive can be most accurately tested. Yet all prudent engineers allow an enormous margin for casualties. The actual strain put on is not half of what the machinery could really bear. Who would subject the plates of a boiler to a pressure just up to their bursting-point? Nature in her mechanics usually makes much more allowance than engineers do. The heart of an animal could send five times the amount of blood that it has to propel at twice the rate of the normal blood-current. The arterial pipes that contain and conduct the blood to the extremities are of sufficient thickness and strength to resist five times the pressure put on them day by day. The stomach in a healthy man has usually the power of digesting twice or thrice the amount of food really needed for nourishing the body. Woe betide the diners-out, if it stopped short just at the point when enough for Nature's wants had been digested! This principle of having a reserve of spare power beyond the ordinary daily needs, only to be called into operation on rare and special occasions, is Nature's principle throughout the whole region of life. She scatters seeds by the million where thousands only can grow.

There is a law of Nature, too, that lies at the very root of the principles I am going to advocate to-night. It is this, that every living being has from its birth a limit of growth and development in all directions beyond which it can not possibly go by any amount of forcing. Man can not add one cubit to his stature. The blacksmith's arm can not grow beyond a certain limit. The cricketer's quickness can not be increased beyond this inexorable point. The thinker's effort can not extend further than this fixed limit of brain-power in each man. This limit is fixed at different points in each man in regard to his various powers, but there is a limit beyond which you can not go in any direction in each faculty and organ.

The capacity for being educated or developed in youth, the receptive capacity of each brain, is definitely fixed as to each brain of each young man and woman.

Then the important laws of hereditary transmission of weaknesses and peculiarities and strong points must be studied and kept in mind, so far as we know them, by the educator of youth. To hear some persons talk, you would imagine that every youth and maid had a constitution as free from faults and weak points, and as little liable to go

wrong, as a forty-shilling watch. Nothing is more certain than that every man and woman is like their progenitors in the main. It takes generations for new conditions of life to eradicate hereditary peculiarities, and then they are always tending to come back. These hereditary peculiarities in youth are mostly not seen as actualities that can be pointed out and proved to exist by any outward signs. They exist as potentialities only, and come out as actual measurable and ascertainable facts at certain ages, or under certain conditions. A young man who inherits gout strongly may for the first five-and-twenty years of his life be absolutely free from any trace of the disease. Yet we are warranted in inferring that something is there which must be taken into account in the diet and conditions of life, if we wish to contract and eradicate the tendency. Many nervous diseases and conditions are the most hereditary of all, and we have good reason to think that, in those subject to them, the conditions of life, and the treatment to which the brain and the rest of the nervous system are subjected during the period of the building of the constitution—that is, during adolescence from thirteen to twenty-five—are of the highest importance in hastening and accentuating, or retarding and lessening, those nervous peculiarities. The problems of the hereditary transmission of qualities and tendencies to disease are some of the most wonderful in nature, and they are as yet by no means clearly elucidated. Many of them, as yet, can not be brought under any law. In our present state of physiological knowledge, it is, for instance, a quite inconceivable thing what takes place when we have two generations of perfectly healthy persons intervening between an insane great-grandmother and an insane great-grandchild. The grandparent and the parent carried something in their constitutions which was never appreciable to us at all. Yet it was there just as certainly as if it had broken out as a disease. It is one of the future problems of physiology and medicine to deduce the exact laws of heredity in living beings, and to counteract the evil hereditary tendencies through conditions of life. To do the latter we shall undoubtedly have to begin early in life, and we shall have to control the education especially, and make it conformable to Nature's indications, laws, and conditions.

Another law of living beings to be kept in mind is this: There is a certain general energy in the organism which may be used in many directions, and may take different forms, such as for growth, nutrition, muscular force, thinking, feeling, or acquiring knowledge, according as it is called out or needed. But its total amount is strictly limited, and if it is used to do one thing, then it is not available for another. If you use the force of your steam-engine for generating electricity, you can not have it for sawing your wood. If you have the vital energy doing the work of building the bones and muscles and brain during the year that a girl grows two inches in height, and gains a stone in weight, you can not have it that year for the acquisition of

knowledge and for study. If by undue pressure you do call up and use for education the energy that ought to go toward growth and strengthening the body, you produce a small and unhealthy specimen of humanity, just like those plants which have had their flowers unduly forced, and are deficient in bulk and hardiness, and will not produce seed. Nature disposes of her energies in a human being in due proportion to the wants of each organ and faculty. There is a natural and harmonious relation which each bears to the other. This relation is different in different persons, and at different periods of life. The plowman takes up most of his energy in muscular effort and in the repair of waste muscle, and he has little left for thinking. The student uses his up in the mental effort of his brain, and has little left for heavy muscular work. No doubt Nature is sometimes prodigal of energy, and provides enough for the high-pressure working of both the brain and the muscles in some cases. But this is not the rule, and should not be assumed as applicable to many persons. At the different periods of life Nature uses up her available energy in different ways. She allocates it in babyhood chiefly to body-growth, in early girlhood partly to growth and partly to brain development; in adolescence, the period of which I am to speak chiefly to-night, her effort is evidently to complete the building up of the structures everywhere, to bring to full development the various functions, to strengthen and harmonize the whole body and the brain, so that they shall be able to produce, and do in the succeeding years of full maturity all that they are capable of. It is certainly not a period of production, but of acquisition. If the original constitution derived from ancestry has been good, if the conditions of life in childhood have been favorable, if the education has been of the right kind, developing the whole being in all her faculties equally and harmoniously after Nature's plan, and if the period of adolescence has crowned and completed every organ and every faculty, no faculty being unduly called on to the impoverishment of the others, then we expect, and indeed must have, a woman in health, which means happiness, with the full capacity for work, for production, and for resisting hurtful influences, and for living her allotted time. But this can only result from a harmonious and healthy *development*, which we may take as the physician's word to denote education in his sense. It can only result from regarding the woman as a unit, body and mind inseparable; it can only result from the educator's efforts being on the lines of Nature's facts, and Nature's harmonies, and Nature's laws.

Another fact in regard to the vital energies and forces of the human body is this: That you may use up by an undue push and pressure at one time of life the power that ought to have been spread out over long periods. We see this daily in men who have had trying or or excited lives and occupations. Some of them wear out soon, and grow old soon, and are old men with no energy or vitality left at fifty.

What you put into one period of life you want at another. If with ten tons of coal in the tender you keep your locomotive running at sixty miles an hour for the first two hours, you do not expect it to do this for long. Each period of life has its peculiar forces and energies in which it is specially rich. In adolescence the strong points, mental and bodily, are very marked. I shall specially allude to them by-and-by. It is sufficient to say here that they are not thinking or intense repression of all the general energies so as to concentrate them in mental work. This may be done, but the question is, Is it well to do it? Does it make life more complete and happy to do so, looking at life as a whole? A physician, like a philosopher, must look on life from the cradle to the grave, not on one portion of it only, as the educationalist is perforce obliged to do, having nothing to do with it afterward. Like many architects and contractors building our houses for us, they turn out an article finished up to the standard of the time, and then hand it over to you. They never see it again. Its future does not concern them much. I have often proposed that your architect and contractor should be bound to come and look at your house every five years for the first twenty, and should get certain deferred payments at these periods according as the work is standing, and no defects developing. So I would have the educator's reputation depend, not on what he has turned out at twenty-one, but on the result at forty or fifty or sixty. Education is a preparation for the work of life, not a thing that is good in itself. If it has helped life to be healthy, happy, successful, and long, then it has been good; if in any degree it has caused disease, unhappiness, non-success, then it has been bad.

There is another vital fact in the constitution of human nature that needs to be taken into account—at least I for one believe it to be a fact. It is this, that one generation may, by living at high pressure, or under specially unfavorable conditions, exhaust and use up more than its share of energy. That is, it may draw a bill on posterity, and transmit to the next generation not enough to pay it. I believe many of us are now having the benefit of the calm, unexciting, lazy lives of our forefathers of the last generation. They stored up energy for us; now we are using it. The question is, Can we begin at adolescence, work at high pressure, keep this up during our lives (which in that case will be on an average rather short), and yet transmit to our posterity enough vital energy for their needs? How often it has happened, in the history of the world, that people who for generations have exhibited no special energy, blaze out in tremendous bursts of national greatness for a time, and then almost die out! The Tartars under Genghis Khan, the Turks when they overawed Europe, the Arabs when they conquered Spain, are examples. We must take care that this does not happen to us. How often we see a quiet country family, that has for generations led quiet, humdrum lives, suddenly produce

one or two great men, and then relapse into greater obscurity than before, or become degenerate and die out altogether!

Another fact in the body and mind history of human beings is this, that there are certain physiological eras or periods in life, each of which has a certain meaning. The chief of such eras are childhood, puberty, adolescence, maturity, the climacteric, and senility. We have to ascertain, What does Nature mean by these eras? What does it strive to attain to in each period? What are the ideal conditions of each? No one of these periods can be studied from a bodily point of view alone, or from a mental point of view alone. They must be regarded from the point of view of the whole living being, with all its powers and faculties, bodily and mental. Not only so, but in most cases the inherited weaknesses must be taken into account too. Those eras of life can not be fully understood looked at with reference to the individual. Their meaning is only seen when the social life, the ancestral life, and the life of the future race, are all taken into account. And this is what makes some proper attention to those eras so very important from the social as well as the physician's point of view. If they are not understood, and so are mismanaged, not only the individual suffers, but society and the race of the future. Particularly the era of adolescence is important, for it is the summer ripening time in the vital history. If the grain is poorly matured, it is not good for either eating or sowing.

Such is the physician's, or perhaps I should rather say the physiologist's, way of regarding a woman, her development, and her education. It is because we do not think the average parent and the professional educator in the technical sense always take this wide view, but that the professional enthusiasm of the latter takes account of, and tries to cultivate, one set of faculties only, viz., the mental; because we think the public mind is getting to regard as all-important in female education what we think is not so important, and so to take little account of what we regard as of supreme importance to the individual and to the race—viz., the constitution and the health—that I think that the physiological view of female education should be brought forward and presented to the public mind more frequently than is the case; while the bad results in after-life of disregarding Nature's laws, as these results come under the notice of the physician, should be strongly and clearly brought before the general mass of parents and educators. It is not a matter that concerns the physician and his immediate patient only. It concerns the whole of the people.

I shall now enter more into detail in illustration of the general principles I have mentioned, as applied to that period of the life of a young woman when the chief part of her education is going on. I am not going to speak much of the period of childhood, or up to the age of thirteen or so. Before that time it is no doubt important that education should be conducted on physiological principles, with due regard

to the growth of the whole organism, and therefore without too many hours of mental work, with plenty of play and rest, and in well-ventilated school-rooms. During the period of childhood few girls will overwork themselves. If it is done, it is by outside pressure, and any bad effects are usually temporary, and easily got over by a little rest, and a good holiday in the country.

The era of adolescence is one of the greatest importance from a bodily and mental point of view in young men and women, but especially in the latter. Bodily, the child eats, sleeps, grows, plays, and does what she is told. Life has no seriousness. Everything in the body and mind is inchoate and unformed. Nothing indicates permanence. There are great and constant muscular energy, noise, sound sleep, quick digestion. The delights of life consist in sweets and games, the imagination is shallow, the affections are instinctive, "character" is nascent; there is no morality in any correct sense, and no real religious sentiment. There is little liability to nervous diseases except those affecting the muscular system; there are no neuralgias, no liability to mental diseases, and most other diseases are sharp and soon over. It is very different with the girl when adolescence commences. Then bodily energies of a new kind begin to arise, vast tracts of brain quite unused before are brought into active exercise. The growth assumes a different direction and type, awkwardness of movement becomes possible, and on the other hand a grace never before attainable can be acquired. The bones begin to cohere and solidify at their ends, and the soft cartilage joinings to get firmer. The tastes for food and drink often change. Bread and butter and sweets no longer satisfy entirely. Stronger and more stimulating foods are craved. The carriage and walk change. The lines of beauty begin to develop. But the mental changes are even more striking. All that is specially characteristic of woman begins to appear; childish things are put away; dolls no longer give pleasure. For the first time distinct individual mental peculiarities show themselves. The effective portion of the mental nature begins to assume altogether new forms, and to acquire a new power. Literature and poetry begin to be understood in a vague way, and the latter often becomes a passion. The imagination becomes strengthened, and is directed into different channels from before. The sense of right and wrong and of duty becomes then more active. Morality in a real sense is possible. A sense of the seriousness and responsibility of life may be said then to awaken for the first time. The knowledge of good and evil is acquired. The religious instinct arises then for the first time in any power. Modesty and diffidence in certain circumstances are for the first time seen. The emotional nature acquires depth, and tenderness appears. The real events and possibilities of the future are reflected in vague and dream-like emotions and longings that have much bliss in them, but not a little too of seriousness and difficulty. The adolescent feels instinctively that she

has now entered a new country, the face of which she does not know, but which may be full of good and happiness to her. The reasoning faculty acquires more backbone, but is as yet the slave of the instincts and the emotions. A conception of an ideal in anything is then attainable, and the ideal is very apt to take the place of the real. The relations and feelings toward the other sex utterly change, and the change makes its subject liable to tremendous emotional cataclysms, that may utterly overmaster the rest of the mental life. There is a subjective egoism, and often selfishness, tending toward objective dualism. There is resolute action from instinct, and there is a tendency to set at defiance calculation and reason. All those changes go hand in hand with bodily changes and bodily development. There is a direct action and interaction between body and mind, all through. Accompanying all these there are, when health is present, a constant ebullition of animal spirits, a joyous feeling, a pleasure in life for its own sake, and there is a craving for light and beauty in something. There should not only be enough energy in the body and mind to do work, but there should be some to spare for fun and frolic, which is just Nature's pleasant way of expending vital force that is not needed at the time for anything else.

For the origination, for the gradual evolution of all these mental changes into perfect womanhood, there are needed corresponding bodily developments. Without these we should have none of those marvelous mental and emotional phenomena properly evolved and developed. If the health is weak, the nutrition poor, the bodily functions disordered and imperfect, and the nervous force impaired, we are liable to have the whole feminine mental development arrested or distorted. If undue calls are made on the nervous force, or the mental power, or the bodily energies, the perfection of nature can not be attained, and womanhood is reached without the characteristic womanly qualities of mind or body. The fair ideal is distorted. The girl student who has concentrated all her force on cramming book knowledge, neglecting her bodily requirements; the girl betrothed who has been allowed to fall in love before her emotional nature was largely enough developed; and the girl drudge who has been exhausted with physical labor—all alike are apt to suffer the effects of an inharmonious, and therefore an unhealthy, mental and bodily constitution. The body and the mind go in absolute unison, just as the blush on the maiden's cheek comes and goes with emotion, as the brightness and mobility of her features go with mental vivacity and happiness.

All those mental and bodily changes are not sudden, nor fully completed and brought to perfection at once; it takes on an average from ten to twelve years before they are fully completed. All that time they are going on, and during that time there is an immense strain on the constitution. All that time the whole organic nature is in a state of what we call instability: that is, it is liable to be upset

in its working by slight causes. The calls on the inherent vital energy to carry on and to bring to the harmonious perfection of full womanhood all these combined bodily and mental qualities I have referred to, during these ten or twelve years, is very great indeed.

We physicians maintain that this period is one of momentous importance, and we have good reason to know this, for we are often called on to treat diseases that arise then, and, having originated then, have been fully matured afterward. The risks and the dangers to body and mind are then very great indeed. We count it a fearful risk to run, not merely that actual disease should be brought on, but that a girl capable of being developed into a healthy and happy woman, with a rounded feminine constitution after Nature's type—the only type that secures happiness and satisfaction to a woman—should by bad management, misdirected education, or bad conditions of life, grow into a distorted, unnatural, and therefore unhappy woman, who can not get out of the life that she has only to live once all that it is capable of yielding her. Like all the other physiological eras of life, that of adolescence only comes once. If the developing process, which is its chief characteristic, is not completed, then it is missed for life. Whatever is done then is final; whatever is left undone is also final. If a woman is not formed at twenty-five, the chances are she will never be so; if she is not healthy then, she probably will not be so. Who in his senses can deny that it is far better for nineteen women out of twenty to be healthy than to be intellectually well educated? No acquirements of knowledge can possibly make up for health in after-life. There is an organic happiness that goes only with good health and a harmoniously constituted body and mind. Without that organic happiness life is not worth having. Cheerfulness is one of the best outward signs of this perfect health, and what woman has not missed her vocation in the world who is not cheerful? A general sense of well-being is the best conscious proof of perfect health. It underlies all enduring happiness. It means good and harmonious development of mind and body, properly working functions, and satisfied organic needs. Any method of education that impairs this must be bad and one-sided.

Here it may be necessary to correct a too common notion that the brain only subserves mental work. To hear the common expression "brain-work," one would imagine that muscular exercise, ordinary employments, and digestion, could go on without the brain's working at all. No idea could be more mistaken. The brain is a most complicated organ in structure and function, that regulates the working of every portion of the body, that has certain portions of it devoted to motion and feeling, and passion, and digestion, and body-growth, and nutrition, etc. It is the one organ that dominates all the others, regulating and harmonizing all their functions. If one side of it is injured during growth, the opposite side of the body is left stunted

and partially paralyzed, as well as the mental power weakened. If undue calls are made on one part, the other portions suffer. Now this wondrous and as yet only partially known organ has grown most of its growth, in so far as mere bulk is concerned, by the time adolescence begins. But its higher qualities—its force, its power of producing varied energies—are then only nascent. They develop during this period. It is then that the brain needs plenty of rest in sleep, fresh air, pure blood, good, nourishing, non-stimulating food, and work that develops but does not exhaust. The mental portion of the brain is no doubt the highest, and undue calls on that portion exhaust more than any other part. As I said, only a certain amount of energy or work is possible by any amount of stimulation. The brain has most diversified functions, but it has also a solidarity of action. No part is sick without all the other parts suffering. No function is overtaxed without all the other functions being weakened. Overtaxing of the mental function is specially weakening. In mature life, after the body is fully developed, such an overtaxing can be repaired by rest. The injury is merely temporary. If a man overworks his brain in business or study, and gives himself too little sleep, and gets an attack of indigestion, it means that he has taken up the brain-energy that ought to have gone toward digestion in mental work. But he stops work, goes to the country, and his recuperated brain soon acquires force enough to stimulate the stomach to secrete its juices and do its work. But if in adolescence, before the bones are knit, and the growth completed, and the feminine nature far advanced toward perfection, if the brain that is in the process of doing all these things is year by year called on to exert its yet imperfect forces chiefly in acquiring book-knowledge by long hours of study, and in consequence the growth is stopped, the blood is thinned, the cheeks are pallid, the fat destroyed, the wondrous forces and faculties that I have spoken of are arrested before they attain completion, then, when the period of growth and development ceases, the damage is irreparable. There is no time or place of organic repentance provided by Nature for the sins of the schoolmaster. Life has to be faced with an imperfect organism, its work and duties done with impaired forces, and its chances of accidents met without a stock of reserve power. This is a poor lookout for the individual; but when motherhood comes, and sound minds in sound bodies have to be transmitted to posterity, how is it to be then with the future race? This aspect of the question of female education during the period of adolescence is of absolutely primary importance to the world. Yet it is wholly ignored in many systems of education. What is the use of culture, if it is all to end with the present generation? What a responsibility to transmit to future generations weak bodies and over-sensitive brains, liable to all sorts of nervous disease! Nothing can be more certain than that the qualities, good and bad, acquired in one generation are sent on to the next. The world may be all the

better of a generation of healthy, ignorant, and happy mothers, who can produce stalwart, forceful sons and daughters (not that I wish this lecture to be an apology for health and ignorance), but the world must be worse for a system of stopping full and harmonious development in the mothers of the next generation. My plea is, that as Nature is harmonious in mental and bodily development, we should follow on her lines, and not set up an educational standard for ourselves that is one-sided, because it takes no proper account of the constitution of the body and brain at all, only considering one brain-function—the mental.

Along with these developments of mind and emotion during adolescence there are, unfortunately, too apt to develop hereditary weaknesses, especially of the nervous kind. Physicians then meet with hysteria, neuralgia, nervous exhaustion, insanity, etc., for the first time. As normal individualities of bodily form and mental character then arise, so abnormal developments arise too where they are inherited or brought on by unfavorable treatment. This law is found to prevail in human constitutions: if you give Nature a good chance by specially favorable conditions, and by counteractive measures early in life, she tends to eradicate evil hereditary tendencies, and to return to a healthy type, if the evil has not gone too far in the ancestry or in the individual. Unfortunately, there are very few families indeed, nowadays, free from tendencies to some hereditary disease or other. Our modern life tends to develop the brain and nervous system, and undue development means risk of disease always. What the profession of medicine specially desires to guard our population now against, is our becoming a nervous race. We want to have body as well as mind; otherwise we think that degeneration of the race is inevitable. And, therefore, we rather would err on the safe side, and keep the mental part of the human machine back a little, while we would encourage bulk, and fat, and bone, and muscular strength. We think this gives a greater chance of health and happiness to the individual, and infinitely more chance of permanence and improvement to the race. This applies to the female sex, we think, more than to the male. Man's chief work is more related to the present (from a physiological point of view), woman's chief work to the future of the world. Why should we spoil a good mother by making an ordinary grammarian?

It will be said, as an hereditary fact, that most great men have had mothers of strong minds. I believe this to be true, but it is not a fact that many great men have had what would now be called "highly-educated" mothers. On the contrary, very few such men have had such mothers. There were usually an innate force and a good development of mind and body in the mothers of such men, who usually had led quiet, uneventful, unexciting lives. I am inclined to believe that if the mothers of such men had been in adolescence worked in learning book-knowledge for eight or ten hours a day in a sitting pos-

ture; if they had been stimulated by competition all that time, and had ended at twenty-one by being first-prize women (as probably most of them had the power of being)—if this had befallen them, then, I think, their sons would have been small and distorted men, instead of being the lights of the world.

One great argument for the "higher education" of women is that it makes them fitter companions for highly-educated men. This view should be looked at in the light of the ideal women that have been created in literature by men and women of genius. If genius has the instinct to discover the highest qualities, and to portray them for our instruction, we should get guidance here. Women have been painted by our poets, dramatists, and creative writers of fiction, by the thousand. Many persons would accept the ideals thus sketched for them as a surer guide than the labored deductions of the scientists. Men of genius ought to have known the kind of women whose companionship they liked, and whose influence on them was best. While they have had to create every kind of woman in peopling the ideal worlds they have made for us, it is certainly very remarkable that the ideal type of the very highly book-educated woman of the modern educationalist is scarcely met with at all. In "The Princess" of our poet-laureate the fancy can not be said to be a serious or imitable one. Though the sentiment of the "sweet girl-graduates with their golden hair" is this:

> "Oh! lift your natures up,
> Embrace our aims: work out your freedom, girls;
> Knowledge is now no more a fountain sealed.
> Drink deep until the habits of the slave,
> The sins of emptiness, gossip, and spite,
> And slander die. Better not be at all
> Than not be noble"—

yet the poet paints the sweetness so as altogether to overpower the learnedness in the picture, and the Princess's ideal and purpose come to naught. And Lady Psyche's dream of likeness and equality is as far as ever from being realized:

> "Everywhere
> Two heads in council, two beside the hearth,
> Two in the tangled business of the world,
> Two in the liberal offices of life,
> Two plummets dropped for one to sound the abyss
> Of science and the secrets of the mind.
> Musician, painter, sculptor, critic move;
> And everywhere the broad and bounteous earth
> Should bear a double growth of these rare souls,
> Poets whose thoughts enrich the blood of the world."

Shakespeare's women are certainly not of the learned sort. Their years of adolescence were not taken up in getting book-knowledge exclusively. Their emotional nature was not dried up by the strain of

intellectual work in youth. Their constitutions were not spoiled by study. They had fair faces, and womanly forms, and warm affections, and strong, impulsive passions, and mother-wit, and keen discernment, and most vigorous resolution, but nothing that we would call learning —not one of them. Portia, who acted the most learned part of all Shakespeare's women, vehemently describes herself as

"An unlessoned girl, unschooled, unpracticed."

George Eliot has created for us a whole host of young women, all real, all true to nature. Herself a woman, and a genius of the highest order; penetrating, learned, accomplished, subtile, and with a power of discriminating language unequaled in our generation; a wife and mother too—she was the best-fitted woman of the age unquestionably to draw for us a picture of young womanhood, highly educated in knowledge, up to the educationalist's ideal. Where do you find such a character in her writings? Dorothea in "Middlemarch" had exactly the makings of the successful omnivorous young female students of the present day; intellectual, conscientious, hyper-conscientious—as such young women so often are to their cost—"studious, her mind was theoretic, and yearned after some lofty conceptions of the world. . . . She was enamored of intensity and greatness." She was self-sacrificing to a fault. She was often ardent, and not in the least self-admiring. Yet Dorothea is not highly educated in the modern sense. Perhaps a modern educationalist would say that that was the reason poor Dorothea made such a mess of it, and threw herself away first on a selfish, shallow old brute, thinking he was a hero, and then on the least interesting fellow in the book.

One of the finest studies of adolescence in the female sex, from the mental side, is Gwendolen Harleth, in "Daniel Deronda." The picture is worthy of study by all persons who take an interest in human nature. Gwendolen was neither good nor studious. She was idle in learning, and she was selfish. She had a vast amount of subjective egoism, tending toward objective dualism, resolute action from instinct, a setting at defiance of calculation and reason, yet acting most reasonably toward the end in view. She was full of sentimentality, of inchoate religious instinct, of a desire for notice. Yet she was undeniably a fine young woman, and is a type of a large mass of the young women whom our modern educationalists would like to set to work for eight hours a day, from the age of thirteen to twenty, acquiring book-learning. I confess I more agree with Hannah More's notion of education for such a girl: "I call education not that which smothers a woman with accomplishments, but that which tends to consolidate a firm and regular system of character, that which tends to form a friend, a companion, and a wife. I call education not that which is made up of shreds and patches, of useless arts, but that which inculcates principles, polishes taste, regulates temper, cultivates reason,

subdues the passions, directs the feelings, habituates to reflection, and trains to self-denial—that which refers all actions, feelings, sentiments, tastes, and passions to the love and fear of God." If to this we add that which hardens the muscles, adds to the fat, quickens and makes graceful the movements, hardens the bones, softens the skin, enriches the blood, promotes but does not over-stimulate the bodily functions, quickens and makes accurate the observation, increases the sense of real beauty of all kinds, promotes the cheerfulness, and develops a sense of universal well-being, we should have, in my opinion, the principles on which an educational system should be founded.

George Eliot's Romola was in a sense a learned woman, brought up in the midst of books, and in the atmosphere of culture. Yet she took to love-making, marriage, self-denial, charity, and religion, and deserted her books the moment her duty in them was done. She had no innate love of book-learning; most of what she had acquired seemed to do her little good in her after-life. It was no guide to her in her difficulties, it was no solace to her in disappointments, it was no resource to her when everything else had failed. It had not taken hold of her nature, because it was not on the great lines on which her nature was constituted. She and her father were as much alike as a man and woman can be. Yet to him his books were an occupation and a delight which he loved, to her their study had been a self-denial all through.

We all know what Thackeray's women were, and yet he stands very high as a faithful student and expounder of human nature, as it exists.

When we look at the sort of women again that these great masters of the study of human character made their heroes fall down and worship, we certainly do not find that the schoolmaster had had much to do with the creation of their attractiveness. Hamlet and Ophelia, Adam Bede and Hetty, Deronda and Gwendolen, Lydgate and Rosamond, are the common types of men above the common mold taking to women of the unlearned if not quite uneducated type. The thoughtful and scientific Lydgate said about pretty, shallow Rosamond: "She is grace itself; she is perfectly lovely and accomplished; that is what a woman ought to be: she ought to produce the effect of exquisite music"; while he said about the stately, thoughtful Dorothea, "The society of such women was about as relaxing as going from your work to teach the second form, instead of reclining in a paradise, with sweet laughs for bird-notes and blue eyes for a heaven."

But it may be said all this was wrong, the result of yielding to unaided, unlearned Nature's lowest affinities, and that it turned out badly for those men. If they had mated suitably, the world would have been better, and they themselves would have been happier. But the physiologist will not readily believe that Nature's mental affinities can be wrong, any more than he can believe that the appetite is not

on the whole the best guide as to the kind and amount of food that is good for us. When he finds in nature a marked masculine and feminine type of being, of body and of mind, marked enough from birth, but diverging widely from the beginning of the physiological era of adolescence, each type tending toward a different ideal, and attaining this at the end of that period; and, recognizing these facts of nature, he finds it most difficult to admit that the same type of education should prevail in this momentous era, or that the same standard and ideal of a completed education should be striven after for the two sexes. And, when he finds that the great geniuses of literature have created these types of young women as different from the masculine type as the Apollo Belvedere is unlike the Venus de' Medici, he can not but become strongly persuaded that his deductions from physiological facts are true, and that they have been always instinctively recognized by the wisest of mankind. If it can be shown that the present tendency to over-educate the female sex in book-learning during adolescence, and the mental work, confinement, etc., that this implies tend to impair perfect health, to interfere with Nature's lines of feminine development, to exhaust energy that is needed for other purposes, and to diminish the chances of the permanence of the race, then it is time that the physiological view in regard to education were put in a plain way to the professional educator and to the parent.

THE CHEMISTRY OF COOKERY.

By W. MATTIEU WILLIAMS.

XVIII.

I FIND that Sir Henry Thompson, in a lecture delivered at the Fisheries Exhibition, and now reprinted, has invaded my subject, and has done this so well that I shall retaliate by annexing his suggestion, which is that fish should be *roasted*. He says that this mode of cooking fish should be general, since it is applicable to all varieties. I fully agree with him, but go a little further in the same direction by including, not only roasting in a Dutch or American oven *before* the fire, but also in the side-ovens of kitcheners and in gas-ovens, which, when used as I have explained, are roasters, i. e., they cook by radiation, without any of the drying anticipated by Sir Henry.

The practical housewife will probably say that this is not new, seeing that people who know what is good have long been in the habit of enjoying mackerel and haddocks (especially Dublin Bay haddocks) stuffed and baked, and cods' heads similarly treated. The Jews do something of the kind with halibut's head, which they prize as the

greatest of all piscine delicacies. The John Dory is commonly stuffed and cooked in an oven by those who understand his merits.

The excellence of Sir Henry Thompson's idea consists in its breadth as applicable to *all fish*, on the basis of that fundamental principle of scientific cookery on which I have so continually and variously insisted, viz., the retention of the natural juices of the viands.

He recommends the placing of the fish entire, if of moderate size, in a tin or plated copper dish adapted to the form and size of the fish, but a little deeper than its thickness, so as to retain all the juices, which by exposure to the heat will flow out; the surface to be lightly spread with butter and a morsel or two added, and the dish placed before the fire in a Dutch or American oven, or the special apparatus made by Burton, of Oxford Street, which was exhibited at the lecture.

To this I may add that, if a closed oven be used, Rumford's device of a false bottom, shown in Fig. 3, of No. 11 of this series, should be adopted, which may be easily done by simply standing the above-described fish-dish, with any kind of support to raise it a little, in a larger tin tray or baking-dish, containing some water. The evaporation of the water will prevent the drying up of the fish or of its natural gravy; and, if the oven ventilation is treated with the contempt I have recommended, the fish, if thick, will be better cooked and more juicy than in an open-faced oven in front of the fire.

This reminds me of a method of cooking fish which, in the course of my pedestrian travels in Italy, I have seen practiced in the rudest of *osterias*, where my fellow-guests were *carbonari* (charcoal-burners) wagoners, road-making navvies, etc. Their staple *magro*, or fast-day material, is split and dried codfish imported from Norway, which in appearance resembles the hides that are imported to the Bermondsey tanneries. A piece is hacked out from one these, soaked for a while in water, and carefully rolled in a piece of paper saturated with olive-oil. A hole is then made in the white embers of the charcoal fire, the paper parcel of fish inserted and carefully buried in ashes of selected temperature. It comes out wonderfully well cooked, considering the nature of the raw material. Luxurious cookery *en papillote* is conducted on the same principle, and especially applied to red mullets, the paper being buttered and the sauce enveloped with the fish. In all these cases the retention of the natural juices is the primary object.

I should say that Sir Henry Thompson directs, as a matter of course, that the roasted fish should be served in the dish wherein it was cooked. He suggests that "portions of fish, such as fillets, may be treated as well as entire fish; garnishes of all kinds, as shell-fish, etc., may be added, flavoring also with fine herbs and condiments according to taste." "Fillets of plaice or skate, with a slice or two of bacon—the dish to be filled or garnished with some previously-boiled haricots"—is wisely recommended as a savory meal for a poor man,

and one that is highly nutritious. A chemical analysis of sixpennyworth of such a combination would prove its nutritive value to be equal to fully eighteenpennyworth of beefsteak.

Some people may be inclined to smile at what I am about to say, viz., that such savory dishes, serving to vary the monotony of the poor hard-working man's ordinary fare, afford considerable moral as well as physical advantage.

An instructive experience of my own will illustrate this. When wandering alone through Norway in 1856, I lost the track in crossing the Kyolen fjeld, struggled on for twenty-three hours without food or rest, and arrived in sorry plight at Lom, a very wild region. After a few hours' rest I pushed on to a still wilder region and still rougher quarters, and continued thus to the great Jostedal table-land, an unbroken glacier of five hundred square miles; then descended the Jostedal itself to its opening on the Sogne fjord—five days of extreme hardship, with no other food than flatbrod (very coarse oatcake), and bilberries gathered on the way, varied on one occasion with the luxury of two raw turnips. Then I reached a comparatively luxurious station (Ronnei), where ham and egs and claret were obtainable. The first glass of claret produced an effect that alarmed me—a craving for more and for stronger drink, that was almost irresistible. I finished a bottle of St. Julien, and nothing but a violent effort of will prevented me from then ordering brandy.

I attribute this to the exhaustion consequent upon the excessive work and insufficient unsavory food of the previous five days; have made many subsequent observations on the victims of alcohol, and have no doubt that overwork and scanty, tasteless food are the primary source of the craving for strong drink that so largely prevails with such deplorable results among the class that is the most exposed to such privation. I do not say that this is the only source of such depraved appetite. It may also be engendered by the opposite extreme of excessive luxurious pandering to general sensuality.

The practical inference suggested by this experience and these observations is, that speech-making, pledge-signing, and blue-ribbon missions can only effect temporary results, unless supplemented by satisfying the natural appetite of hungry people by supplies of food that is not only nutritious, but savory and *varied*. Such food need be no more expensive than that which is commonly eaten by the poorest of Englishmen, but it must be far better cooked.

Comparing the domestic economy of the poorer classes of our countrymen with that of the corresponding classes in France and Italy (with both of which I am well acquainted), I find that the raw material of the dietary of the French and Italians is inferior to that of the English, but a far better result is obtained by better cookery. The Italian peasantry are better fed than the French. In the poor *osterias* above referred to, not only the Friday salt fish, but all the

other viands, were incomparably better cooked than in corresponding places in England, and the variety was greater than is common in many middle-class houses. The ordinary supper of the "roughs" above named was of three courses: first a *minestra*, i. e., a soup of some kind, continually varied, or a savory dish of macaroni; then a ragout or savory stew of vegetables and meat, followed by an excellent salad; the beverage a flask of thin but genuine wine. When I come to the subject of cheese, I will describe their mode of cooking and using it.

My first walk through Italy extended from the Alps to Naples, and from Messina to Syracuse. I thus spent nearly a year in Italy, during a season of great abundance, and never saw a drunken Italian. A few years after this I walked through a part of Lombardy, and found the little *osterias* as bad as English beer-shops or low public-houses. It was a period of scarcity and trouble; "the three plagues," as they called them—the potato-disease, the silk-worm fungus, and the grape-disease—had brought about general privation. There was no wine at all; potato-spirit and coarse beer had taken its place. Monotonous *polenta*, a sort of paste or porridge made from Indian-corn meal, to which they give the contemptuous name of *miserabile*, was then the general food, and much drunkenness was the natural consequence.

XIX.

Referring to No. 17 of this series (November "Monthly"), a correspondent who has just returned from Norway, where he followed the route of my last trip there, reminds me of the marvelous congregation of sea-birds that assembles on some of the headlands of the Arctic Ocean, and suggests that egg-oil might be obtained in large quantities there. He quotes from the work of P. L. Simmonds on "Waste Products" the following: "In the Exhibition of 1862 the Russian Commission showed egg-oil in large quantities and of various qualities, the best so fine as to far excel olive-oil for cooking purposes"; but it was not sufficiently cheap for general use.

Among the places indicated by Mr. Grimwood Taylor, the most remarkable is Sverholt Klubben, a grand headland between the North Cape and Nord Kyn, rising precipitously from the sea to a height of above one thousand feet. The face of the rock weathers perpendicularly, forming a number of ledges about two or three feet above each other, and extending laterally for more than a mile. On the two occasions when I passed it, the whole of this amphitheatre was occupied by a species of gull, the "kittiwake," perched on the ledges, their white breasts showing like the shirt-fronts of an audience of a million or two of male pygmies in evening dress. On blowing the steam-whistle, the rock appeared to advance, and presently the sky was darkened by a living cloud, and every other sound was extinguished by a roar of wings and the harsh, wailing screams of a number of birds that

I dare not estimate. The celebrated bird colony on the Bass Rock is but a covey compared with this.

The inhabitants of the little human settlement in the Bay of Sverholt derive much of their subsistence from the eggs of these birds; but whether they could gather a few millions for oil-making, without repeating the story of the goose and the golden eggs, is questionable. The eider-ducks that inhabit some of the low mossy islands thereabout, are guarded by strict legislative regulations during their incubation period, lest they should emigrate, and the down-harvest be sacrificed.

I now come to the subject of *stewing*, more especially the stewing of flesh food. Some of my readers may think that I ought to have treated this in connection with the boiling of meat, as boiling and stewing are commonly regarded as mere modifications of the same process. According to my mode of regarding the subject, i. e., with reference to the object to be attained, these are opposite processes.

The object in the so-called "boiling" of, say, a leg of mutton is to raise the temperature of the meat throughout just up to the cooking temperature (see Nos. 3 and 4) in such a manner that it shall as nearly as possible retain all its juices; the hot water merely operating as a vehicle or medium for conveying the heat.

In stewing nearly all this is reversed. The juices are to be extracted more or less completely, and the water is required to act as a solvent as well as a heat-conveyer. Instead of the meat itself surrounding and enveloping the juices as it should when boiled, roasted, grilled, or fried, we demand in a stew that the juices shall surround or envelop the meat. In some cases the separation of the juices is the sole object, as in the preparation of certain soups and gravies, of which "beef-tea" may be taken as a typical example. *Extractum Carnis*, or "Liebig's Extract of Meat," is beef-tea (or mutton-tea) concentrated by evaporation.

The juices of lean meat may be extracted very completely without cooking the meat at all, merely by mincing it and then placing it in cold water. *Maceration* is the proper name for this treatment. The philosophy of this is interesting, and so little understood in the kitchen that I must explain its rudiments.

If two liquids capable of mixing together, but of different densities, be placed in the same vessel, the denser at the bottom, they will mix together in defiance of gravitation, the heavy liquid rising and spreading itself throughout the lighter, and the lighter descending and diffusing itself through the heavier.

Thus, concentrated sulphuric acid (oil of vitriol), which has nearly double the density of water, may be placed under water by pouring water into a tall glass jar, and then carefully pouring the acid down a funnel with a long tube, the bottom end of which touches the bottom of the jar. At first the heavy liquid pushes up the lighter, and its upper surface may be distinctly seen with that of the lighter resting

upon it. This is better shown if the water be colored by a blue tincture of litmus, which is reddened by the acid. A red stratum indicates the boundaries of the two liquids. Gradually the reddening proceeds upward and downward, the whole of the water changes from blue to red, and the acid becomes tinged.

Graham worked for many years upon the determination of the laws of this diffusion and the rates at which different liquids diffused into each other. His method was to fill small jars of uniform size and shape (about four ounces capacity) with the saline or other dense solution, place upon the ground mouth of the jar a plate-glass cover, then immerse it, when filled, in a cylindrical glass vessel containing about twenty ounces of distilled water. The cover being very carefully removed, diffusion was allowed to proceed for a given time, and then by analysis the amount of transfer into the distilled water was determined.

I must resist the temptation to expound the very interesting results of these researches, merely stating that they prove this diffusion to be no mere accidental mixing, but an action that proceeds with a regularity reducible to simple mathematical laws. One curious fact I must mention, viz., that, on comparing the solutions of a number of different salts, those which crystallize in the same forms have similar rates of diffusion. The law that bears the most directly upon cookery is that "the quantity of any substance diffused from a solution of uniform strength increases as the temperature rises." The application of this will be seen presently.

It may be supposed that, if the jar used in Graham's diffusion experiments were tied over with a mechanically air-tight and water-tight membrane, brine or other saline solution thus confined in the jar could not diffuse itself into the pure water above and around it; people who are satisfied with anything that "stands to reason" would be quite sure that a bladder which resists the passage of water, even when the water is pressed up to the bursting-point, can not be permeable to a most gentle and spontaneous flow of the same water. The true philosopher, however, never trusts to any reasoning, not even mathematical demonstration, until its conclusions are verified by observations and experiment. In this case all rational preconceptions or mathematical calculations based upon the amount of attractive force exerted between the particles of the different liquids are outraged by the facts.

If a stout, well-tied bladder that would burst rather than allow a drop of water to be squeezed mechanically through it be partially filled with a solution of common washing-soda, and then immersed in distilled water, the soda will make its way out of the bladder by passing through its walls, and the pure water will go in at the same time; for if, after some time is allowed, the outer water be tested by dipping into it a strip of red litmus-paper, it will be turned blue, showing the presence of the alkali therein, and, if the contents of the bladder be weighed or measured, they will be found to have increased by the in-

flow of fresh water. This inflow is called *endosmosis*, and the outflow of the solution is called *exosmosis*. If an India-rubber bottle be filled with water and immersed in alcohol or ether, the endosmosis of the spirit will be so powerfully exerted as to distend the bottle considerably. If the bottle be filled with alcohol or ether and surrounded by water, it will nearly empty itself.

The force exerted by this action is displayed by the rising of the sap from the rootlets of a forest giant to the cells of its topmost leaves. Not only plants, but animals also, are complex osmotic machines. There is scarcely any vital function—if any at all—in which this osmosis does not play an important part. I have no doubt that the mental effort I am at this moment exerting is largely dependent upon the endosmosis and exosmosis that is proceeding through the delicate membranes of some of the many miles of blood-vessels that ramify throughout the gray matter of my brain. But I must wander no further beyond the kitchen, having already said enough to indicate that exosmosis is fundamental to the philosophy of beef-tea extraction, and reserve further particulars for my next paper.

POSTSCRIPT.—I feel bound to step aside from the proper subject of these papers to make public acknowledgment of an act of honorable generosity, especially as many hard things have been said concerning American plagiarism of the work of British authors. As everybody knows, we have no legal rights in America, and any publisher there may appropriate as much of our work as he chooses. American *legislators* are responsible for this. Nevertheless, I received, a short time since, a letter from Mr. E. L. Youmans, of New York, inclosing a check for £20, as an *honorarium*, in consideration of the fact that these papers are being reprinted in "The Popular Science Monthly." Shortly before this, a similar remittance was sent from another publishing firm (Messrs. Funk & Wagnalls), who have reprinted "Science in Short Chapters." These facts indicate that some American publishers have larger organs of conscientiousness than the present majority of American legislators.

I am told that another American publisher has issued another reprint of "Chemistry of Cookery" without making any remittance; but, as Mr. Proctor would say, "this is a detail."—*Knowledge.*

VINOUS SUPERSTITIONS.

BY DR. TH. BODIN.

ALTHOUGH the world no longer believes in the gods, demi-gods, and heroes with which the ancients and our pagan ancestors animated nearly every object, old-country people still retain a considerable relic of heathenism in the shape of myths of a host of spirits of

nature which are all the time at work to produce prosperity and success or destruction.

In Alsace, the eye of the traveler is gladdened by the view of the picturesque vine-lands which stretch in almost unbroken succession along the slopes of the Vosges and Jura Mountains, heavy with handsome clusters of grapes. We can hardly wonder that the country people, feeling a similar delight, but one modified according to their different habit of thought, should attribute the prosperity of their vine-crops to higher powers; and it is easily explainable that in their childish fancies they, half in earnest, half in humor, allow these genii of old to continue to live and do their beneficent work. Especially characteristic of these children of Bacchus, to which a variety of most pleasant legends are attached, are prophecies respecting the success or failure of the next vintage, predictions that make themselves known by visible or audible signs.

Thus, in the spring, when the air is scented with the fragrance of the blossoms, and everything points to an abundant vintage, the people believe they can hear in the hill at Brunstatt the "Wigigerle" fiddling lustily to the accompaniment of ringing glasses and dancing. If, however, the vintner's prospects for the year are dull, the smell of the blossoms is only faint, and the attentive listener can only occasionally hear the sound of the strings, while the hill seems empty and desolate.

A pendant to the jolly "Wigigerle" (wine-fiddler) is the "White Lady of Paulinus Castle" who haunts the region of Weissenburg. She is believed to wander at night through the vines, and occasionally to make her appearance in the day-time. In case the year is to be unprosperous, she shows herself rarely, closely veiled, bearing a bunch of hidden keys, wearing a sad face, and weeping much; but, if the vintage is to be rich, she greets the vine-dressers cheerily, and rattles her keys gayly as she passes through the gardens.

The Alsatians also regard as an infallible wine-oracle the cellar of Arnsberg Castle, which belongs to the family of the Fesslers, a race of sturdy drinkers who became extinct in the seventeenth century, and is popularly called the Devil's Castle. The immense stocks of wine supposed to lie in the deep and spacious caverns have not been touched for centuries; for the most industrious search has failed to discover a door or any way by which an entrance to them can be forced. In good seasons, a sweet odor of wine arises from the ground at the time of the blooming of the vines, and diffuses itself around.

St. Hunna, formerly one of the richest ladies of Alsace, is honored as the patron of the poor, thirsty topers of the town of Hunnasweihen, in bad years. This pious woman, who was a friend and comforter of the poor in the seventh century, sometimes condescended so far as to wash the clothes of her maids, whence she got the name of the saintly laundress. A copious spring, flowing through four outlets, has been

consecrated to her memory, and is known far and wide as the Hunna Spring. It occasionally happens in years when wine is scarce, so the story runs, that, when the people go to the spring of mornings and evenings to water their horses and cattle, wine flows out of all the outlets; and those who can boast that they have enjoyed this wine say that it is better than any other.

A St. Morand is honored as the patron of the vintners of a district near Worms, in consequence of a legend that the commune was once blessed, in answer to his prayers, with an unusually abundant harvest. Two portraits of him may be seen in the church at Steinbach, in one of which he is represented as holding a bunch of grapes and pressing out the juice with his hand.

The property is attributed to several springs in Alsace, of flowing only when the harvests are to be abundant.

According to the superstition in another region, if one will go to the Geisbrunn of Freiburg, in Breisgau, at midnight on New Year's, he will find a little man there, who in silence will give some very significant tokens. If the year is to be a good one, he will bear three ears of corn in one hand and three bunches of grapes in the other, and will make friendly gestures. If the year is going to be bad, he will have a sour face and empty hands.

The vineyard is surrounded, in Germany and other countries, by numerous poetic superstitions. The Swabians say that the grapes will receive a fine flavor if the vines are shaken on St. John's day. The Bavarians have a proverb that, if one would have good wine, he must write on his cask, "O taste and see that the Lord is good" (Psalm xxxiv, 8); and the South-Germans have a proverb, "If one would make good vinegar from wine, he must throw the names of three witches into it."

In Switzerland, the country people freshen up their stale wine by laying dead toads on the bung-holes of the casks. The ancient Germans were mindful of their gods at their feasts, when they strove to distinguish themselves as great drinkers; and the pious custom of drinking to the health of their divinities was binding among them. The North-Germans were accustomed at certain feasts to empty a cup to Bragi, and by that act to assume a promise to emulate the bold deeds of that god. Such promises were irrevocable. Bargains were therefore bound by a kind of drink-offering in order to obtain the favor of the gods. At the heir's-feast bumpers were drunk to the memory of the departing one; and on other occasions glasses were emptied in honor of those who were absent. These customs, from which our toasts appear to be derived, were not abolished in Christian times: only the saints succeeded to the rights of the gods. St. Martin, it is said, at his own desire, took the place of Donar; St. Gertrude received the honors that had been paid to Freya; and Njörd and Frey appear to have surrendered their functions to the first martyr of the

Church, St. Stephen. At Freiburg the Johannites were accustomed to hang a stone, representing one of those thrown at Stephen, to a silver chain. Wine was poured upon the stone and then given to the faithful to drink. Memorial drinks to St. Michael and St. John the Evangelist were also very common. Departing guests and travelers were accustomed to drink "John's blessing" as well as in memory of St. Gertrude; and a number of mythical stories are associated with these draughts.

St. Gertrude is said to have drunk a St. John's draught with a knight who had entered into a pact with the devil, and thereby to have delivered him. Since St. Gertrude was the patron of sailors, and her chapel at Bonn, near the Rhine, was much visited by seafaring people, it is easy to explain why the draughts to her honor were drunk in a glass shaped like a ship. It is still customary in some Roman Catholic churches to bless a cup of wine on St. John the Evangelist's day (the 27th of December), and commend to the people the memory of the beloved disciple. These customs are not observed outside of Germany. In Catholic Germany it is usual to celebrate a first festival at the house with the wine (generally red wine) which has been blessed at the church, and to give to the whole family to drink out of the same cup; a few drops are even poured out for the baby in the cradle. Part of what is left is preserved, and part is poured into the cask, to impart its blessing to what is there and turn all evil spells from it. Speculative Swabian hosts often consecrate large quantities of wine for the entertainment of their guests and neighbors; and the popular fancy prevails that, if such of this wine as has been kept over the whole year is drunk on the annivesary of the day of its consecration, it will bring recovery to the sick, and protection and strength to those who are about to start on a journey. Engaged couples taste this wine at their betrothals, when it is offered to them by the priest after having blessed it. If one drinks it on the day it is consecrated, he is secured for the whole year against poisoning, witchery, and lightning. It is an old Bavarian custom for the father to drink a "John's blessing" before departing on a journey, and then, swinging the cup backward over his head, to cast a few drops on the ground. The "John's blessing" on St. John the Baptist's day, June 24th, which the South-German Protestants observe socially, without making a church festival of it, is doubtless related to the Catholic custom.

The John's blessings have been referred to the cup drunk by the disciples, or perhaps to the wedding at Cana of Galilee; but we think we have shown that they are derived from the old heathen thank-offerings, and the sacramental wine has probably been also brought within the scope of the usage by popular fancy. Many healing powers are attached to this wine in some places, and it is sometimes called in as the last and surest remedy in extreme cases. That industrious investigator of folk-lore, M. Töppen, says on this subject in his work on

the superstitions of the Masures, that "consecrated communion-wine is used in all diseases as the most sovereign and last resort. The Masures often ask their pastors for it. If they will not give it to them, they go to the Catholic priests, who grant their requests without hesitation. They frequently have the wine blessed at the Catholic confessionals; and some of them think that communion-wine from Catholic churches is more efficacious than that from evangelical churches. Nevertheless, Catholics sometimes go to evangelical pastors to get their communion-wine." Herr C. G. Hintz, another writer on folk-lore, mentions it as a time-honored custom in old Prussia to put a bottle of wine on the altar, so that it may be blessed at the sacramental service.

The beliefs on this subject are in some cases contradictory: thus, while the Lauenburg peasant regards the communion-wine as a sovereign cure, and calls in the priest when he finds the doctor too dear, or that his remedies fail, the people of Oldenburg and East Prussia put off the taking of the sick-bed communion as long as possible, for fear that it will be followed by a speedy death.—*Translated for the Popular Science Monthly from Die Natur.*

MALARIA AND THE PROGRESS OF MEDICINE.*

THE attempt to estimate the successes of medicine on the grand scale is met at the outset by a source of fallacy which can not well be eliminated. Medicine has certainly a share, and it may be a very large share, in the general lengthening of life, in the decrease of pain and suffering, and in the increase of working-power; but other influences, besides the thought and endeavor of the medical profession, have helped to bring about those results. A brief consideration of malarial fever (including simple ague and the more deadly tropical forms), of the causes that have made it less common at home, and more amenable to treatment everywhere, and of the views entertained about it, will serve to show how various are the forces that make for improved well-being, and how checkered the medical record has been. No single cause of premature death, of life-long misery, and of loss of working-power, has ever equaled malaria. There is some reason to think that it was from personal experience of the ague, and the hepatic derangements consequent on it, that Descartes got his profound conviction of ill-health being the greatest of all hindrances to the wisdom and capability of the individual. There can, at least, be hardly any question that malaria is, and always has been, the

* Abstracted from an article entitled "The Progress of Medicine," in the "Quarterly Review" for July, 1883.

largest single element in the miseries of mankind. Fortunately, malarial fever has almost disappeared from Great Britain, and it has hardly existed in some of our colonies, particularly the Australasian; it has decreased considerably in many parts of Northern Europe and the United States. Again, there is a drug, cinchona-bark, with its products, which has a great power over the course of the fever. The cultivation of the cinchona-tree is now a great industry both in the Eastern and Western Hemispheres, and whatever quinine or other products of the bark can do for malarious sickness will be, at no distant time, a benefit that may be shared by all but the very poorest and the races least accessible to civilization. Lastly, the symptoms, course, and complications of the intermittent and remittent fevers which malaria causes are known with all the precision that can be wished. What share, then, has medicine had in dealing with this destroyer of human happiness in the past, and what is the attitude of medicine toward malaria at present?

The almost total extinction of malaria at home and its decrease abroad have been brought about in the ordinary course of draining and cultivating the soil, and by a wise attention to the planting or conservation of trees. There is a characteristic passage at the end of Kingsley's novel "Hereward," in which he commemorates his hero as the first of the new English "who, by the inspiration of God, began to drain the fens." The draining of the fens and all such achievements throughout the world have brought better health with them, but neither the doctors nor even the sanitarians have been the primary moving forces. Again, the medicinal uses of cinchona-bark were known first to the indigenous inhabitants of the Peruvian Andes, where the trees are native and where the ague is common; and it was the Jesuits who introduced it widely into Europe (1630) and the East. The story of the reception of this remedy by the medical profession has its unpleasant side. The arch-stupidities of the Paris faculty, who still live for the amusement of the world in Molière's comedies, opposed it with their united weight. Court physicians in other European capitals than Paris assailed it with abuse, and no one wrote more nonsense about it than Gideon Harvey, the physician of Charles II. The new remedy, apart from its merits, fell in with the views of the Paracelsists, and disagreed with the views of the Galenists, and was recommended or condemned accordingly. Even the great Stahl, nearly a century after cinchona was first brought to Spain, would have none of it, and, in his servitude to his theories, he even went so far as to make use of Gideon Harvey's ignorant tirade against the drug by reprinting it in German. As late as 1729, an excellent physician of Breslau, Kanold, whose writings on epidemics are still valuable for their comprehensive grasp, declared in his last illness (a "pernicious quartan") that he would sooner die than make use of a remedy which went so direct against his principles! The world, of

course, gave little heed to these inane disputations; the value of cinchona was beyond the power of the faculty either to discover or to obscure. But, on behalf of the faculty, it remains to add that cinchona found powerful advocates within it from the first; and it will not surprise any one to be told that these were generally the men whom medical history, on other grounds as well, has extolled or at any rate saved from oblivion. Such were Sydenham and Morton in London, Albertini in Bologna, Peyer in Schaffhausen, and Werlhof in Hanover. The therapeutic position of cinchona was firmly established by Torti's treatise on the treatment of periodical fevers, published at Modena in 1709.

The next step in the relief of malarious sickness on the grand scale was the extraction of the alkaloid quinine from the cinchona-bark. The powdered bark was not only very unpalatable, but it was cumbrous to carry and dispense, and, although the principle of the remedy remained the same, it has proved of infinitely greater service in the form of quinine, and in the form of the cheap alkaloidal mixture known in Bengal as "quinetum." The first extraction of an alkaloid was in the case of morphia, from opium, in 1805; the discoverer was an apothecary of Hameln, who was rewarded rather better than the celebrated piper of that town, for the French Academy of Sciences voted him two thousand francs. Quinine was discovered in 1820 by the French chemists Pelletier and Caventou. The sciences and arts of botany and practical forestry, of chemistry and practical pharmacy, are now all concerned in the production of this most invaluable of remedies. The commerce of the world has taken cinchona in hand, and there are now plantations of the trees not unworthy to be named beside those of coffee and tea. The value of the crude bark imported into England alone in 1882 was nearly two millions sterling. The original and native cinchona region on the damp eastern slopes of the Andes in Peru is still a source of wealth, and a still greater source of wealth are the new plantations on the Andes in Bolivia. The Indian Government has successfully cultivated the bark on a large scale in the Nilghiri Hills in Madras, and more recently at Darjiling in the Himalayas; while a crowd of private planters have followed in the same enterprise in Coorg, Travancore, and Ceylon. The Dutch Government, who were the pioneers of cinchona cultivation, have found the climate and soil of Java well adapted for the species and varieties of trees most rich in quinine. Jamaica is the latest field to which this new and ever-increasing industry has extended.

How does quinine control, modify, or cut short an attack of ague? This is a question with which the commerce of the world can not grapple, but only the medical profession; and the truth requires it to be said, that the medical profession knows little of the *modus operandi* of quinine in ague. Sydenham, two hundred years ago, laid down the two great rules for the administration of bark: to give it after the

first paroxysm and in the subsequent intervals, and to continue its use as a precaution against the recurrence of the fever. Little remained to be added to these practical indications; they were empirical, indeed—and they are empirical still. The profession is not even sure whether quinine acts by breaking the recurrent habit of ague (as an anti-periodic), or otherwise. There are also the most conflicting statements as to whether the taking of quinine will ward off the attack of ague in passing through a malarious locality; there are a good many reasons for believing that quinine has no preventive or anticipatory action against the first onset of a remittent or intermittent fever, but the professional advice will probably be that quinine taken as a preventive can at least do no harm.

But it is when we leave the sphere of empirical experience, and enter the physiological and pathological workshops of the profession, that we realize most acutely how great is the disproportion, in this matter of malaria, between the opportunities of medicine and its achievements. Take, for example, the following sufficiently eclectic statement on the physiological actions of quinine:

> Quinia, $C_{20}H_{24}N_2O_2$, one of the alkaloids of cinchona, in small doses accelerates the heart's action in the warm-blooded animal; in moderate doses it slows it; and in large doses it may arrest it, and cause convulsions and death. Research shows that its action is essentially upon the central nervous system. It destroys all microscopic animal organisms, apparently killing vibrios, bacteria, and amœbæ; but it seems to be without action on humble organisms belonging to the vegetable kingdom. It arrests the movements of all kinds of protoplasm, including those of the colorless corpuscles of the blood. It arrests fermentive processes which depend on the presence of animal or vegetable organisms, but it does not interfere with the action of digestive fluids.—(Quain's "Dictionary of Medicine," p. 35.)

There is here something for everybody; and, if we now go to the pathological workshop, we shall discover the beautiful adaptation of these varied actions of quinine to the various opinions that are entertained of the malarious fevers over which the drug has so powerful an influence. Is malarial fever a fermentive process, depending on the presence of animal or vegetable organisms? then quinine arrests such processes. Is malarial fever caused by a profound disturbance of the nervous mechanism which regulates the animal heat? then the action of quinine is "essentially upon the central nervous system." Nothing could be more accommodating, and nothing more unsatisfactory.

The theoretical notions about malaria form an instructive page of medical history. Until about 1823 it was always thought to be associated with marshes and swamps, but in that year Dr. William Fergusson brought to England numerous proofs that it occurred abundantly in elevated and rocky regions. Such evidences have gone on accumulating, and it is now well known that malaria has no necessary connection with the marsh. But the profession is still profoundly

impressed with the belief that malaria is an actual or material poisonous substance. To Homer it was the arrows of Apollo in anger, to the mediæval folk-lore it was the mischief of elves and sprites; and, if scientific medicine does not now permit us to personify the malaria, it teaches us at least to materialize it. Although the fevers which malaria produces are quite unlike the fevers that are contagious or communicable, the present scientific guides of the profession are resolved to find a material virus or poison as the cause of them. The malarial poison was sought for, in the early days of chemistry, among the various gases of the marsh, but the chemical search proved fruitless. When the microscope came in, the miasm was diligently looked for in the soil of malarious localities and in the vapors overhanging them. From 1849 to the present year, some twenty different vegetable organisms or their spores, of very various degrees of complexity, have been described each in its turn as the malarious miasm and as the specific cause of remittent and intermittent fevers; and the quest for a material substance assumed to be the cause of malarial fever is regarded with much favor in the best scientific circles. Meanwhile a body of opinion, which takes due account of all the manifold associated circumstances of malaria throughout the world, has been forming, and yearly growing in volume, that there is no malarious miasm at all; that "malaria," indeed, is a profound disorganization of the nervous mechanism that presides over the temperature of the body; and that this upsetting of the heat-regulating center is likely to happen when the body has been exposed during the day to extreme solar heat and to fatigue, and exposed at sundown and in the night to the tropical or sub-tropical chill, which will be severe in proportion to the rapid cooling of the ground and the amount of vapor condensed in the lowest stratum of the air. There is no more beautiful mechanism in nature than that which keeps man's internal heat always about 98° day and night, summer and winter, in the Arctic regions or in the tropics; but even that most wonderful of all self-adapting pieces of mechanism, if it be taxed too much, as by extremes of day and night temperature, will get out of gear; and a fever, still retaining something of the diurnal periodicity, will be the result. No one can read the powerful criticism * of Surgeon-Major Oldham, of the Indian Medical Service, without discovering this rational explanation of malaria to have the best of the facts and the best of the logic on its side.

The decision of this point of theory one way or another has the most momentous issues, not so much for the treatment of malarious fever as for its prevention. It is, in short, a question, on the one hand, of common prudence in warm countries, more often moist than arid, and more often level than mountainous, against exposure of the body to the direct action of the sun's rays and to the nightly chill

* "What is Malaria? and why is it most intense in Hot Climates?" London, 1871, 8vo, pp. 186.

that follows; or, on the other hand, of a fatalist doctrine of vegetable spores or organisms of the lowest grade making ceaseless war upon mankind. The world has a way of finding out the truth by its experiences on the large scale. It settled the inane theoretical objections to the value of cinchona-bark, and it will probably form its own opinion on the relative merits of the vegetable-spore theory of malaria and the theory of exposure and climatic vicissitudes. It will be a regrettable circumstance if in this matter the profession has to follow public opinion instead of leading it.

THE LOESS-DEPOSITS OF NORTHERN CHINA.

By FREDERICK W. WILLIAMS.

SCIENTISTS as well as economists and statesmen are turning with a scrutiny, renewed as each year advances, toward the great region of middle Asia—a territory which, if it supplies society with immigrants much too thrifty for the tastes of our broader-minded Celtic brethren, bids fair in many ways to furnish materials for scientific research that can be compared in interest to no other portion of the world's surface. Without delaying to mention here the recent travelers who are rapidly lessening the bounds of that tract, still confessed to be the least known area of the globe, it is our purpose to direct attention to a geological phenomenon among the most important as well as peculiar of any hitherto brought to light in this field of investigation: we mean the loess-beds covering a great portion of Northern China.

The term *loess*, now generally accepted, has been used to designate a tertiary deposit appearing in the Rhine Valley, along the Danube, and in several isolated sections of Europe. Its formation has heretofore been ascribed to glaciers, but its enormous extent and thickness in China demand some other origin. The substance is a brownish-colored earth, extremely porous, and, when dry, easily powdered between the fingers, when it becomes an impalpable dust that may be rubbed into the pores of the skin. Its particles are somewhat angular in shape, the lumps varying from the size of a peanut to a foot in length, whose appearance warrants the peculiarly appropriate Chinese name meaning "ginger-stones." After washing, the stuff is readily disintegrated, and spread far and wide by rivers during their times of flood. Mr. Kingsmill, in the "Journal of the Geological Society" (London), states that a number of specimens, which crumbled in the moist air of a Shanghai summer, rearranged themselves afterward in the bottom of a drawer in which they had been placed. Every atom of loess is perforated by small tubes, usually very minute, circulating after the manner of

root-fibers, and lined with a thin coating of carbonate of lime. The direction of these canals being always from above downward, cleavage in the loess mass, irrespective of size, is invariably vertical, while, from the same cause, water in falling upon a deposit of this material never collects in the form of puddles or lakes on its surface, but sinks at once to the local water-level.

The loess territory of China begins, at its eastern limit, with the foot-hills of the great alluvial plain—roughly speaking, upon the line drawn from Peking to Kaifung in Honan. From this rises a terrace of from ninety to two hundred and fifty feet in height, consisting entirely of loess; and westward of it, in a nearly north and south line, stretches the Tai-hang Shan, or dividing range between the alluvial land and the hill-districts of Shansi. An almost uninterrupted loess-covered country extends west of this line to Lake Koko-nor and headwaters of the Yellow River. On the north the formation can be traced from the vicinity of Kalgan, along the water-shed of the Mongolian steppes, and into the desert beyond the Ala Shan range. Toward the south its limits are less sharply defined; though covering all the country of the Wei basin (in Shensi), none is found in Sz'chuen, due south of this valley, but it appears in parts of Honan and Eastern Shantung. Excepting occasional spurs and isolated spots, loess may be considered as ending everywhere on the north side of the Yangtse Valley, and, to convey a general notion, as covering the parallelogram between longitudes 99° and 115° east, and latitudes 33° and 41° north. The district within China Proper represents a territory half as large again as that of the German Empire, while outside of the provinces there is reason to believe that loess spreads far to the east and north, possibly in varying thicknesses quite across the desert. Baron von Richthofen observed this deposit in Shansi to a height of 7,200 feet above the sea, and supposes that it may occur at higher levels.

One of the most striking as well as important phenomena of this formation is the perpendicular splitting of its mass—already referred to—into sudden and multitudinous clefts that cut up the country in every direction, and render observation as well as travel often exceedingly difficult. The cliffs, caused by erosion, vary from cracks measured by inches to cañons half a mile wide and hundreds of feet deep; they branch out in every direction, ramifying through the country after the manner of tree-roots in the soil—from each root a rootlet, and from these other small fibers—until the system of passages develops into a labyrinth of far-reaching and intermingling lanes. Were the loess throughout of the uniform structure seen in single clefts, such a region would indeed be absolutely impassable, the vertical banks becoming precipices of often more than a thousand feet. The fact, however, that loess exhibits in every locality a terrace formation, renders its surface not only habitable, but highly convenient for agricultural purposes; it has given rise, moreover, to the theory advanced by Kingsmill and

some others, of its stratification, and from this a proof of its origin as a marine deposit.

But, since attention was first directed to this formation by Mr. Pumpelly, in 1864, its structure has been more carefully examined by other geologists, whose hypotheses are pretty generally discarded for that of Baron von Richthofen. This gentleman, who may be considered *facile princeps* among foreign geologists who have visited China, argues that these apparent layers of loess are due to external conditions, as of rocks and *débris* sliding from surrounding hill-sides upon the loess-dust as it sifted into the basin or valley, thus interrupting the homogeneity of the gradually rising deposit. In the sides of gorges near the mountains are seen layers of coarse *débris* which, in going toward the valley-bottom, become finer, while the layers themselves are thinner and separated by an increasing vertical distance; along these rubble-beds are numerous calcareous concretions which stand upright. These are, then, the terrace-forming layers which, by their resistance to the action of water, cause the broken chasms and step-like contour of the loess regions. Each bank does, indeed, cleave vertically, sometimes—since the erosion works from below—leaving an overhanging bank; but, meeting with this horizontal layer of marl-stones, the abrasion is interrupted, and a ledge is made. Falling clods upon such spaces are gradually spread over their surfaces by natural action, converting them into rich fields. When seen from a height in good seasons, these systems of terraces present an endless succession of green fields and growing crops; viewed from the deep cut of some stream or road-bed, the traveler sees nothing but yellow walls of loam and dusty tiers of loess-ridges. As may be readily imagined, a country of this nature exhibits many landscapes of unrivaled picturesqueness, especially when lofty crags, which some variation in the water-course has left as giant guardsmen of fertile river-valleys, stand out in bold relief against the green background of neighboring hills and a fruitful alluvial bottom, or when an opening of some ascending pass allows the eye to range over leagues of sharp-cut ridges and teeming crops, the work of the careful cultivator.

The extreme ease with which loess is cut away tends at times to seriously embarrass traffic. Dust made by the cart-wheels on a highway is taken up by strong winds during the dry season and blown over the surrounding lands, much after the manner in which it was originally deposited here. This action, continued over centuries, and assisted by occasional deluges of rain, which find a ready channel in the road-bed, has hollowed the country routes into depressions of often fifty or a hundred feet, where the passenger may ride for miles without obtaining a glimpse of field or landscape. Lieutenant Kreitner, of the Szechenyi exploring expedition (whose pleasant article on Thibet appeared in "The Popular Science Monthly" for August, 1882) illustrates, by a personal experience when in Shansi, the difficulty and dan-

ger of departing from the highway when in one of these deep cuts; after scrambling for miles along the broken loess above the road, he only regained it when a further passage was cut off by a precipice on the one side, while a jump of some thirty feet into the beaten track was his only alternative upon the other.

Difficult as may be such a territory for roads and the purposes of trade, its advantages to a farmer are manifold. Wherever this deposit extends, there the husbandman has an assured harvest two and even three times in a year. It is easily worked, exceedingly fertile, and submits to constant tillage, with no other manure than a sprinkling of its own loam dug from the nearest bank. But loess performs still another service to its inhabitants. Caves made at the bases of its straight clefts afford homes to millions of people in the northern provinces. Choosing an escarpment where the consistency of the earth is greatest, the natives cut for themselves rooms and houses, whose partition-walls, cement, beds, and furniture are made *in toto* from the same loess. Whole villages cluster together in a series of adjoining or superimposed chambers, some of which pierce the soil to a depth of often more than two hundred feet. In costlier dwellings the terrace or succession of terraces thus perforated are faced with brick, as well as the arching of rooms within. The advantages of such habitations consist as well in imperviousness to changes of temperature without as in their durability when constructed in properly selected places—many loess dwellings outlasting six or seven generations. The capabilities of defense in a country such as this, where an invading army must inevitably become lost in the tangle of interlacing ways, and where the defenders may always remain concealed, are very suggestive.

There remains, lastly, a peculiar property of loess which is perhaps more important than all other features when measured by its man-serving efficiency. This is the manner in which it brings forth crops without the aid of manure. From a period more than two thousand years before Christ, to the present day, the province of Shansi has borne the name of "Granary of the Empire," while its fertile soil, *hwang-tu*, or "yellow earth," is the origin of the imperial color. Spite of this productiveness, which, in the fourteenth century, caused Friar Odoric to admiringly call it "the second country in the world," its present capacity for raising crops seems to be as great as ever. In the nature of this substance lies the reason for this apparently inexhaustible fecundity. Its remarkably porous structure must, indeed, cause it to absorb the gases necessary to plant-life to a much greater degree than other soils, but the stable production of those mineral substances needful to the yearly succession of crops is in the ground itself. The salts contained more or less in solution at the water-level of the region are freed by the capillary action of the loess when rain-water sinks through the spongy mass from above. Surface moisture, following the downward direction of the tiny loess-tubes, establishes a

connection with the waters compressed below, when, owing to the law of diffusion, the ingredients, being released, mix with the moisture of the little canals, and are there taken from the lowest to the topmost levels, permeating the ground and furnishing nourishment to the plant-roots at the surface. It is on account of this curious action of loess that a copious rainfall is more necessary in Northern China than elsewhere, for with a dearth of rain the capillary communication from above, below, and *vice versa*, is interrupted, and vegetation loses both its moisture and manure. Drought and famine are consequently synonymous terms here.

As to the origin of loess, Baron von Richthofen's theory is substantially as follows: The uniform composition of this material over extended areas, coupled with the absence of stratification and of marine or fresh-water organic remains, renders impossible the hypothesis that it is a water-deposit. On the other hand, it contains vast quantities of land-shells and the vestiges of animals (mammalia) at every level—both in remarkably perfect condition. Concluding, also, that from the conformation of the neighboring mountain-chains and their peculiar weathering, the glacial theory is inadmissible, he advances the supposition that loess is a subaërial deposit, and that its fields are the drained analogues of the steppe-basins of Central Asia. They date from a geological era of great dryness, before the existence of the Yellow and other rivers of the northern provinces. As the rocks and hills of the highlands disintegrated, the sand was removed, not by water-courses seaward, but by the high winds ranging over a treeless desert landward, until the dust settled in the grass-covered districts of what is at present China Proper. New vegetation was at once nourished, while its roots were raised by the constantly arriving deposit; the decay of old roots produced the lime-lined canals which impart to this material its peculiar characteristics. Any one who has observed the terrible dust-storms of Northern China, when the air is filled with an impalpable yellow powder, which leaves its coating upon everything, and often extends in a fog-like cloud hundreds of miles to sea, will understand the power of this action during many thousand centuries. This deposition received the shells and bones of innumerable animals, while the dissolved solutions contained in its bulk staid therein, or saturated the water of small lakes. By the sinking of mountain-chains in the south, rain-clouds emptied themselves over this region with much greater frequency, and gradually the system became drained, the erosion working backward from the coast, slowly cutting into one basin after another. With the sinking of its salts to lower levels, unexampled richness was added to the wonderful topography of this singular formation.

Mr. Pumpelly, while accepting this ingenious theory in place of his own (that of a fresh-water lake deposit), adds that the supply of loess might have been materially increased by the vast *mers-de-glace*

of High Asia and the Tien Shan, whose streams have for ages transported the products of glacial attrition into Central Asia and Northwestern China. Again, he insists that Richthofen has not given importance enough to the parting planes, wrongly considered by his predecessors in the study of Chinese geology as planes of stratification. "These," he says, "account for the marginal layers of *débris* brought down from the mountains. And the continuous and more abundant growth of grasses *at one plane* would produce a modification of the soil structurally and chemically, which superincumbent accumulations could never efface. It should seem probable that we have herein, also, the explanation of the calcareous concretions which abound along these planes; for the greater amount of carbonic acid generated by the slow decay of this vegetation would, by forming a bicarbonate, give to the lime the mobility necessary to produce the concretions."

It is hardly within the scope of this article to do more than present in brief outline an exposition of the loess-theory that has made its orginator already celebrated throughout Germany. Nor can we follow Baron von Richthofen further into the extension of his postulate, wherein one is scarcely surprised at finding a plausible and attractive application of this idea of loess-formation to the entire Europe-Asiatic Continent, to the pampas of the South and prairies of the North American world. While the three or four northwestern provinces of China exhibit undoubtedly the strangest and most picturesque features of this formation, its influence upon the climate of Central Asia, the reactionary effect of this upon the surface configuration of the steppe-lands, and thus on the historical and ethnographical development of the cradle of the human race, are but some of the legitimate generalizations—if not necessary results—coming from this interesting phase of nature.

THE NATURAL SETTING OF CRYSTALS.

By J. B. CHOATE.

THE study of natural history has of late years been largely directed to the observation of laws according to which the development of the individual species and genus takes place. Although the vital principle which determines the growth and the nature of the animal or plant eludes the search of shrewd and practiced observers, yet the modes in which that principle manifests itself are in many cases pretty well understood. In numberless instances we have been shown the purpose with which Nature works on unceasingly toward certain definite anticipated ends. It is this fixed intent of Nature, rationally and hopefully pursued, which reveals the thought of the universe. The

processes of growth and of change are evident enough to be familiar, but it is the reason for these phenomena which so often makes them miracles of wonder to the observer. Care, intelligence and skill will everywhere be seen, but there is a marked distinction between the growth that goes on under the supervision of an intelligence wholly external to the form which is brought into being, as in the case of a crystal, and that development which is made according to instinctive or conscious tendencies implanted in the germ.

Tree, shrub and grass show evidence of effort on the part of the individual directed to quite obvious ends. The form assumed is in every instance such as to enable the plant to resist the violence to which it may be exposed. All the energies controlled by vital force are directed to supplying wants felt or anticipated. The tree in its growth develops strength where strength is needed, just as man by exercise increases his muscular power. In the formation of crystals another law predominates. It matters not whether these are safely hidden away in the caverns of the earth, or are exposed to risk of destruction upon its surface. They usually occur attached to one another, or to the faces of the rock. In the latter case, such as have unequal axes will be found so placed as to have their longest axes at right angles to the surface to which they are attached, or, if the surface be curved, this axis will be at right angles to the plane tangent to the curve at that point. This arrangement will be seen most plainly upon examination of a geode lined with quartz-crystals. It provides for the setting of the largest number of crystals upon a given surface, but puts them in the position of the least stable equilibrium quite unlike the sturdy posture assumed by a tree deeply rooted to the soil, and having its fibers most strongly interlaced in the region of its base. This setting of crystals displays them to the best advantage, but it leaves them more exposed to abrasion than would any other position, and more likely to be removed from their place. No provision has been made to guard against external violence, and in this may be found a striking point of distinction between an animate and an inanimate entity.

SURFACE CHARACTERS OF THE PLANET MARS.*

SCHIAPARELLI continued his observations of the topography of the planet Mars during its last opposition, i. e., from October 26, 1881, to the end of February, 1882, and his results were communicated in a preliminary report early in March to the Accademia dei Lincei, of Rome.

Owing to the prevailing weather, his observations were restricted

* Translated for "The Popular Science Monthly" by Marcus Benjamin, Ph. B., F. C. S.

to fifty days—from the end of December to the beginning of February. Among these, sixteen evenings were remarkably favorable, so much so that the greatest magnifying powers could be used.

It was therefore possible, notwithstanding the fact that the apparent diameter of Mars was not over 16″ (against 19″ in 1877), to obtain results which surpass all previous endeavors. Beginning with the white polar spots, Schiaparelli first mentions that the northern polar spot was always more or less visible. During the months of November and December it appeared separated into several branches or masses, as was also the case in 1879. In the latter half of January these branches began to amalgamate and form a regular, continuous, and uniform *calotte*, the diameter of which reached about 50° at the beginning of February, and then decreased in a distinctly noticeable manner; while, on the contrary, the southern polar spot remained invisible during the entire period of the observations, even in January and February, when the south pole entered the field of view 2°. From this, in connection with the experience gained in 1879 relative to the visibility of the spot, he concludes that eight months after the southern solstice it had not yet attained a diameter of 20°—a diameter which, according to the observations during the previous opposition, it generally attained to a few weeks before this solstice.

During the course of the observations, various white or whitish spots made their appearance at the southern edge of the planet, greatly resembling the polar spot, but after exact examination and measurement proved to be one or the other of the well-known southern islands of the planet, which appeared white around their edges in consideration of a property peculiar to these localities.

The dark portion (ocean?) which surrounds these islands did not seem to possess this property; and, in order to explain how the polar spot, during the southern winter on Mars, can occupy a part of this locality, it becomes necessary to make the assumption that at such times this part undergoes such changes that it is enabled to appear of a bright white color.

Similar white or whitish spots were observed at intervals at other points of the yellow surface of the planet; some of the better determined points, which had already been noticed in 1877 and 1879, were also visible on this occasion, while others remained invisible. A number of white spots were observed, which, however, were only temporary, particularly in the neighborhood of the northern polar *calotte*. Emanating from this position, there often would be noticed white inclined stripes passing toward the equator of the planet; the arrangement of these seemed to be dependent upon the rotation of Mars—other positions near the edge of the planet likewise presented a whitish appearance.

A general dimming of the white spots which hid the configuration of the planet was observed on the 18th of January, between

the meridians of 40° and 120°. It extended only over the yellow portions, which are supposed to be continents, and often covered the canals, but completely avoided the darker portions, which represent the oceans and larger lakes. It was not a contiguous covering, but consisting of white or whitish spots, which were irregularly distributed.

The atmosphere of Mars appears to have been more transparent than during 1877. Not only the luminous and the opaque zone of the rim were smaller, but in some parts of the planet the contrast between the light and shade was more distinctly visible with an inclined illumination, and so it was possible to more readily distinguish objects at the edge of the planet than at the center.

During November the north pole advanced some 7° to 8° within the circle of the visible hemisphere; but the hope of being enabled to examine the surface in the vicinity of this pole was unrealized on account of the unfavorable weather. For this reason the limit of the chart of 1881–'82 does exceed 60° north latitude, and, hence, does not extend much beyond the portions explored in 1879; but the parts lying between 30° and 60° northern latitude could be more closely examined. On this occasion also the lower end of the chart is limited by a series of dark stripes which appear to be connected with the northern ocean. The peculiar character of the surface of Mars can not, however, be well explained until after the next opposition. It was impossible to explore the southern ocean with exactness beyond 50° south, although all of the islands which had previously been recognized were observed as white spots similar to the polar snow. All of the smaller seas which branch off from the equator were very distinct in their configuration. The continents and the interior lakes between the bright equatorial zone and the south ocean could be drawn with the greatest accuracy. A few changes in the appearance of particular portions as compared with their shape in 1879 were noticed, and as hundreds of thousands of square kilometres of surface, which were formerly light, had in the mean while become dark, so on the other hand many of the sections which previously were dark now became luminous. These changes prove that the darkening principle which produces them is due to something which is movable and extends over the surface of the planet (for instance, water or some other liquid), or perhaps something capable of being transmitted from place to place (such as vegetation).

Not one of the old dark lines which have been called "canals" was missing, and causes which in all probability were due to the sun produced numerous phenomena, which in former oppositions were only suspected. That brilliant, light-red color mixed with white, which in 1877 occupied the whole of the equatorial zone and a large part of it in 1879, was found in 1882 to be entirely absent. Undefined shadows began to form in this luminous veil surrounded by stains of

an orange-yellow color; these shadows become darker by degrees, concentrate themselves and absorb bodies by changing into groups of more or less black lines; at the same time the orange color extends, and finally, with but little exception, covers the whole of the so-called continental zone.

The large areas of the so-called "Alcionia" ocean and gulf, which in 1879 appeared to belong to the "ocean," resolved themselves into complicated bunches of definite lines. Finally, one could see what we have every reason to believe is the true aspect of the planet. Besides this, we noticed the peculiar and unexpected phenomena of the *doubling* of the canals, which will probably tend to considerably alter the present views of the physical characters of the planet. This doubling is clearly not an optical effect, dependent upon the increased optic power, as is the case in the double stars; nor is it produced by the longitudinal division of a canal. It takes place under the following circumstances: To the right or left of an existing line, without any change in its direction or position, another parallel line is produced which differs from the first in appearance and direction only in exceptional cases. Between the lines so produced, the distance varied from 12° to 6° (350 to 700 kilometres). Among certain of the lines doubling could only be suspected, but not observable at the small distance (5°) separating them. Sometimes a line was darker or broader at two or more points, and the accompanying line would also show this peculiar feature. The length of each pair may differ considerably, and vary from 15° to 80°. Some were of a reddish-brown color, somewhat darker than the ground from which they could be distinguished; others, generally the finer ones, were very dark. The broader ones formed true bands, the sides of which were perfectly parallel. They followed (as far as could be judged without exact measurements) the direction of the large circles of the planet, and only in a few cases were they bent off toward the side. No irregularities could be observed among them with the magnifying (417) power used. Certain of them show such great regularity that they might be designated as a series of parallel lines drawn by the aid of a ruler. In some cases, several pairs would combine, one behind the other, and form a double polygonal line; with very definitely marked angles such a series would occupy a great extent. This phenomenon of doubling appears to be connected with certain epochs—and it takes place almost simultaneously over the entire surface of the planet, covered by the bright portions (continents ?). Not a trace of these was observed in 1877 during the weeks which followed the southern solstice of the planet. A single isolated instance was noticed in 1879 on the 26th of December. The appearance of this doubling was the more surprising, as a careful examination on December 23d and 24th gave no cause for suspecting any such change. During the last opposition, a reappearance of this phenomenon was impatiently looked for, but it did not show itself for

two months, and then later than was expected; at first indistinct and dim, but becoming more distinct on the following day. This was one month after the autumnal equinox of Mars. The doubling continued to be visible until after the end of February. On the 11th of January another doubling had already made its appearance, but was not further noticed because the canals which doubled were very irregular. Great, therefore, was our surprise to find that, on the 19th of January, a canal which passed through the center showed two straight parallel lines, which, on repeated examination, were found to be true phenomena. From this date the number of canals appearing doubled increased; even on the 24th of February when the apparent diameter of Mars had been reduced to less than 10°, the doubling of the canals could be distinguished. In an aggregate (exclusive of a few cases which could not be configured on account of the insufficient power of the telescope to define such delicate cases), some twenty cases of doubling were noticed, seventeen of which occurred in the course of one month, i. e., from January 19th to February 19th—the mean of the time corresponding to about the end of the second month after the autumnal equinox of the planet. In addition to these there were probably others which made their appearance; but, unfortunately, the unfavorable weather and the increasing distance of the planet prevented a successful following up of the further development of these highly important phenomena. In a few cases it was possible to determine some premonitory signs of the doubling.

On January 13th a very light and indefinite shadow began to spread itself parallel to the canal known as "Ganges"; on the 18th and 19th these portions were covered with white spots, on the 20th the Ganges appeared to be composed of two lines, but the phenomenon was still doubtful; on the 21st the doubling was distinct and remained so until February 23d. Similar observations were made on other lines.

Everything leads to the conclusion that we have here a periodical phenomenon, which is probably connected with the seasons of Mars. If this be the case, we may hope to extend these observations during the next opposition, when we shall be able to see the seasons of the planet advanced about eighty days. This opposition will take place January 1, 1884. The position of Mars on this date will be identical with that on the 13th of February, 1882, and the apparent diameter will be about 12·9″, that is, pretty near the mean diameter which the planet had during the finding of the above-described doublings. Therefore there is reason to hope that these phenomena may again be determined and confirmed by other observers. The desire to obtain such information has been the main object of the foregoing communication.

THE NEW PROFESSION.

By HENRY GREER.

IT is but a few years since the practical student of electrical science was limited to the single branch of telegraphy. His choice lay between becoming a telegraph operator and a manufacturer of telegraph instruments. The telegraph operators form a numerous and intelligent body of men; sharp competition exists among them, and for a long time they had scarcely any chance of improving their position, because until recently no other branch of electrical engineering was open to them. But, during the last dozen years, great progress has been made in various and new applications of electricity. Skilled electrical engineers are few; and any one, who has acquired a practical knowledge of several branches of electricity, will find no difficulty in keeping himself profitably employed.

Until lately, the young electrician's great desire was to qualify himself for submarine telegraphy. The work of *testing* and localizing faults in cables is of a more scientific and interesting character than work in other departments of telegraph engineering. The manufacture of cables is also a subject for particular study, and a fair knowledge of mechanical engineering may be gained by practice in it. Two of the many different departments of electrical engineering, telephony and electric lighting, are becoming especially important, and yet there is great difficulty in finding competent electricians to accomplish the work.

During a recent sojourn in Europe, I learned that not only young men, but educated women also, were studying electrical engineering, and that large fortunes have been made in it. The enormous extension of the telegraphic system, and the wonderful advances made in electricity, electric lighting, telephony, electrical cables, and railways, and in the transmission of power, offer great advantages to persons seeking profitable employment. Telegraph engineering or electrical engineering is a new profession. More than this, it is one which is not yet overcrowded, and it is, therefore, undoubtedly an occupation which many of our college graduates will adopt.

The ultimate value of the advances which have recently been made in electrical science can not now be estimated. The great electrician, Professor Clerk Maxwell, was asked shortly before his death, by a distinguished scientist, "What is the greatest scientific discovery of the last quarter of a century?" His reply was, "The discovery that the Gramme machine is reversible." The ordinary electrician would have called the telephone, the Faure accumulator, or the Edison electric light, the greatest discovery, but Professor Maxwell's deep and philo-

sophic mind perceived that in the fact he named, which to so many of us might seem little more than a curious experiment, lay the principle which, if rightly developed, would make practicable the transmission of power.

If, now, we could call back this great electrical engineer, and ask him what recent discovery came next in importance to this, what would he reply? His answer would be the discovery that "a voltaic battery is reversible." The Gramme machine has given us means of transmitting power of electricity. The later discovery enables us to store up electrical energy as distinguished from electricity.

Electrical engineering, which embraces a knowledge of cables, telegraphy, electric lighting, electrical measurement, transmission of power, storage-batteries, and how to localize faults in cables, land lines, and telephone lines, has thus become a subject of the first practical importance.

A prominent department of the electrical engineer's work is the localizing of faults in ocean-cables, which may be of five different kinds: 1. Where the copper conductor makes a "perfect earth." 2. Where the copper conductor is broken, and yet the insulation remains unbroken. 3. Where an "imperfect earth" is made. 4. Faults arising from a hole in the gutta-percha sheath, making a connection between the conductor and the sea. 5. From the establishment of a connection between the iron sheathing and the copper core, by a nail or wire driven in.

The first kind of fault is easily located, because we know the resistance of the cable when it is in perfect working order. If, for instance, it has 10,000 *ohms*, or units of resistance, a fault making a perfect earth midway in the cable would give us 5,000 ohms resistance. Or, we know how many ohms of resistance there are to a mile of cable when it is in perfect working order, and, by the use of delicate instruments and by mathematical calculations, we can easily locate the fault.

The location of the second class of faults, i. e., a complete breakage of the conductor, naturally followed by a total cessation of all communications between the two ends of the cable, may be detected in several ways. The charge which the cable will contain is first measured; and, when the charge per mile is known, the amount actually observed will directly give the location of the faults; and the exactness with which the position of the break can be determined is limited only by the accuracy with which the relative charges can be compared. Suppose, for instance, the discharge from a mile of the cable with a given battery, and reflecting galvanometer, is represented by a deflection of ten divisions, and the discharge from a cable containing a broken copper conductor is one hundred divisions, we know the fault is about ten miles from the shore.

A fault of the fourth kind is located very readily. There is a

great fall in the insulation resistance, and a slight fall in the apparent resistance of the copper conductor, between the two stations; but messages can be still transmitted, as a part only of the whole current, inversely proportional to the resistance of the fault, escapes into the ocean. If one office insulates the cable, and the other measures the resistance, the fault acts like a fault that is caused by the fracture of both the copper wire and the gutta-percha, but little of the copper core being exposed.

The fifth kind of fault corresponds almost exactly in behavior to a fault caused by fracture of the copper conductor and gutta-percha, in which a considerable portion of the length of copper wire remains exposed to the water. The resistance will vary still less; and there will be a total absence of the feeble currents which result when the copper and iron of a cable are broken and separated by salt water.

Submarine or ocean telegraphy holds a very prominent place in electrical engineering, and the instruments used in it are interesting. In instructing pupils a very curious apparatus is used. It is the artificial or dummy cable, consisting of a number of "resistance-coils," and condensers so arranged as to reproduce all the phenomena and all the practical difficulties that are presented by a real ocean-cable. With a good instructor, this piece of apparatus is of very great service, inasmuch as all kinds of imperfections can be readily and correctly imitated in any part of the circuit.

Still greater interest, perhaps, attaches to the apparatus for showing the retardation that a current experiences in traversing a long cable. This apparatus consists of a series of "resistance-coils," "rheostats," and condensers, having small receiving instruments at a dozen different points in the circuit, representing as many different offices on the line. The receiving instruments are similar to the mirror portion of Sir William Thomson's mirror galvanometer. In this a ray of light falls upon a very small mirror attached to a small magnet; and this rotates around a vertical axis when acted upon by a current that circulates in a coil of wire. These magnets, with the mirrors attached, moving one after the other, indicate the time taken in charging the whole length of the circuit.

I. The Storage of Electricity.—Another principal branch of electrical engineering, promising much in the near future, is the great French discovery of the storage of electrical energy. It is among the most important inventions of the last thirty years. The electrical storage of energy must not be confounded with the storage of electricity. An electrical storage-battery is an apparatus for transforming electricity; in it electrical energy is no longer produced directly, but changes its properties. A given source furnishes a certain volume or quantity of electricity, at a certain pressure or tension. In certain instances, it may be important to increase one of these prop-

erties at the expense of another, as in mechanics it is often required to transform speed into force or force into speed by means of fly-wheels or driving-wheels. The apparatus which produces this charge is called the electrical transformer. These machines can be divided into two large classes: 1. As regards tension; and, 2. As regards quantity. The storage-batteries of Thomson, Planté, d'Arsonval, and Varley, belong to the quantity class. All these batteries have a common use. They store electrical energy and give it out transformed. Secondary couples are electrical accumulators, as well as transformers.

II. The Electric Light.—It is clear that this wonderful application of electricity is thus far only in its infancy, and that it must either supplement or supplant gas-lighting in the near future. In it educated persons of either sex may, after a thorough course of training, easily find very remunerative employment in a fast-developing branch of the new profession. With all the older professions overcrowded, an electrical engineer's prospects are, to-day, undoubtedly bright, especially if he has some knowledge of mechanics, though this is not absolutely necessary. Very great impetus has, also, been given to electrical industries by the invention of the telephone, electrical storage-batteries, fire-alarm telegraphs, district telegraphs, and the introduction of the electric light into the domain of our domestic economy. In all these branches there are more places than qualified persons to fill them.

III. Training for the New Profession.—The person who is educated simply as a mechanical engineer, or simply as a telegraph engineer, can not at once make himself useful in the wider range of the new profession which has created itself. The requisites for an electrical engineer are, theoretical and practical knowledge of physics, including mechanics and mathematics. The first questions to be asked a parent, who desires his son to be an electrician, are: "Has your son been studying physics at the ordinary school? Has he ever made any experiments himself, or does he see experiments made by the lecturer?" Let this son commence his technical education at once, for he can learn more of real science in the interval of rest, during his technical education, than he will ever acquire if he devotes himself to books. By a technical college we mean one in which a general education in the application of science to industries is given to all the students, and a special education in the applications of science to individual students.

Electrical engineering has thus a deeper interest for the parents of America than they know. A knowledge of mechanical drawing and designing is essential; and new designs of instruments should be put before the students for use and study, as it is important to cultivate in them the powers of original thought and combination. Next to machine designing and drawing, in the education of an electrical engineer, is a practical knowledge of electricity. And by this I mean far

more than an ordinary acquaintance with the effects of glass electrical machines, sealing-wax experiments, etc., etc. The knowledge must be experimental, and it must be quantitative, not merely qualitative. No person ever learned electricity from a book. If one wants to know why a particular *dynamo* is more efficient than another, he must enter on a course of professional education, like that of studying medicine or reading law. Night after night, in England, many young men come thirty miles to learn how the efficiency of an electric lamp, storage-battery, or a dynamo-machine, is actually measured—how to obtain experimentally the characteristic curves of dynamo-machines of different speeds, calibrating galvanometers, testing magnets, etc.

It would not have been extremely difficult to give lectures on electrical engineering twenty years ago, but the development of the science now is so great that it would be an exceedingly laborious matter to prepare a course on the subject without efficient apparatus. Of the importance of such lectures there can be no doubt, and the time will come when the principles, at least, of electrical engineering will be taught in our schools. The new developments of the science and art can hardly be exaggerated; and while at one time scientific men were of the opinion that the popular mind erred in supposing that electricity would supersede steam as a motive power, engines are now employed to produce power, while electricity affords us the very best means yet discovered of distributing that power.

Electricity does not yet take the place of steam, but it takes the place of cogs, wheels, belting, etc.

A word as to the time necessary to become an electrical engineer. It is claimed by some that six months' study suffices to make a good electrician; but experience teaches us that a year and a half of assiduous work would not be by any means too much.

In conclusion, I may say that this is a profession suitable for women of a scientific, studious, or inventive turn of mind. It is not a profession requiring physical force, but rather keen abilities, good mathematical and scientific training, and the special education of the telegraph engineer.

I can not suggest a brighter prospect for young men, or for intelligent and energetic young women, who wish to learn a profession, than this art, which year by year is steadily assuming more and more importance.

CONCENTRIC RINGS OF TREES.

By A. L. CHILD, M. D.

IN the December number (1882) of the "Monthly," you published an article prepared by me, on the "Annual Growth of Trees," which has been somewhat largely commented upon, in the periodicals and press of the day, as also by the "American Congress of Forestry" at St. Paul. I am glad to note this interest in the subject, as it will cause more accurate observation of the facts in the case. As many of my critics have apparently read only extracts from the article, and have accordingly drawn very incorrect inferences as to my views, I wish to restate some of the more important points, and the evidence sustaining them.

In June of 1871 I planted a quantity of seed as it ripened and fell from some red-maple trees. In 1873 I transplanted some of the trees from these seeds, placing them on my city lots in Plattsmouth, Nebraska. In August, 1882, finding them too much crowded, I cut some out, and, the concentric rings being very plain and distinct, I counted them. From the day of planting the seed to the day of cutting the trees was two months over eleven years.

On one, more distinctly marked (although there was but little difference between them), I counted on one side of the heart forty rings. Other sides were not so distinct; but in no part were there fewer than thirty-five. There was no guess-work about the age of this tree. A daily record of meteorological events for the Smithsonian Institution and Signal-Office for over twenty years, and a life-long habit of daily record of all important events, had led to much care and caution in such matters. Hence, from my own record, I *knew* the tree had but twelve years of growth; and yet, as counted by myself and many others, it had forty clear concentric rings.

Here permit me to quote a few lines from the original article, which, so far as I have seen, have been entirely ignored or overlooked by all commentators: "I could select twelve more distinct ones (rings) between which fainter and narrower, or sub-rings, appeared. Nine of these apparently annual rings on one section were peculiarly distinct; much more than the sub-rings. But, of the remaining, it was difficult to decide which were annual and which were not." When first cut, and while the wood was green and the cells filled with sap, these rings were very clear and plain; but, as the water evaporated and the wood contracted, they showed less plainly. I have a section of it now before me, and I can not make out clearly over twenty-four, where, when green, forty were clearly visible. This section was not at first so distinctly marked as a section forwarded to Professor Cleveland

Abbe, of the Signal-Office, at his request; although that, when forwarded, showed the rings much less conspicuously than when fresh and green.

Mr. P. C. Smith, in the August (1883) "Monthly," supporting the commonly received reliability of the rings, as an index to the age of the tree, refers to certain disputed corners and lines marked by hacks on trees, and the agreement of the number of the subsequent rings with the record of the surveyor. This indicates an uncertainty in the matter which is hardly receivable as scientific proof. If the record was reliable, why question the hack? If only for confirmatory evidence, how identify the one hack among the many which on old lines invariably accumulate in the vicinity of disputed lines by many resurveys? Is it not a mere assumption that the rings do indicate a like number of years; and that, as the record agreed with these rings, therefore, that hack was *the one?* Mr. Smith says, "It will be very difficult to convince an old surveyor, or an old lawyer, who has tried many of these land cases, that each concentric ring on an oak-tree, at least, does not indicate a year's growth only of such tree." Well, I am an old surveyor, having followed the business more or less for upward of fifty years, and the evidence before me admits of but the one possible conclusion; and, had Mr. Smith or any other intelligent man the same evidence, I am sure there could be no disagreement between us on the subject.

The Hon. James J. Wilson, of Bethel, Vermont, an "old lawyer" and late Senator in the State Legislature, writes me, under date of August 15th, that at a trial in the District Court at Woodstock, Vermont, on a disputed line based upon a cut on a hemlock-tree, a section of the tree embracing the cut was produced in court, and the rings outside the cut counted up from forty to fifty, while those on the opposite side were only nine or ten! The verdict of the court was, that "the rings were not a sure indication of the age of the tree."

Hon. Robert W. Furness, late Governor of Nebraska, so well known as a practical forester, has kindly furnished me with several sections of trees of known age, from which I select the following: A pig-hickory eleven years old, with sixteen distinct rings; a green-ash eight years old, with eleven very plain rings; a Kentucky coffee-tree ten years old, with fourteen very distinct rings, and, in addition to these, twenty-one sub-rings; a burr-oak ten years old, with twenty-four equally distinct rings; a black-walnut five years old, with twelve rings. Governor Furness adds that he has a chestnut of four years, with seven rings; a peach of eight years, with six rings; and a chestnut-oak of twenty-four years, with eighteen rings. He attended the recent meeting of the American Association for the Advancement of Science, at Minneapolis, Minnesota, and presented this question and his specimens to the section on forestry. He reports that Professor Budd, of the Iowa Agricultural College, presented also a specimen

spruce from Puget's Sound, of known age, or nearly fifteen years old. The section was twelve inches in length, and on one end had eighteen rings and on the other end had only twelve. Commissioner Loring expresses the opinion that "this settled the question, that rings at all times could not be relied upon as an index of the age of trees."

Hon. J. T. Allan, of Omaha, superintendent of tree-planting for the Union Pacific Railroad Company, in a recent letter says: "Any intelligent man, who has given any attention to this matter of yearly tree-growth, knows that the rings are no index of a tree's age. H. P. Child, superintendent of the Kansas City stock-yards, shows me a section of pine eight years old, with nineteen rings, and a soft maple of nearly fourteen years, with sixteen very distinct rings, in addition to which there are forty-seven less distinct sub-rings."

In conclusion, that the more distinct concentric rings of a tree approximate, or in some cases exactly agree, in number with the years of the tree, no one, I presume, will deny; but that in most and probably nearly all trees, intermediate rings or sub-rings, generally less conspicuous, yet often more distinct than the annual rings, exist, is equally certain: and I think the foregoing evidence is sufficient to induce those who prefer truth to error to examine the facts of the case.

These sub-rings or additional rings are easily accounted for by sudden and more or less frequent changes of weather and requisite conditions of growth—each check tending to solidify the newly-deposited cambium, or forming layer; and, as long intervals occur of extreme drought or cold, or other unfavorable cause, the condensation produces a more pronounced and distinct ring than the annual one. Query: Has a tree grown in a conservatory, or place of unchanged conditions of heat and moisture, any concentric rings?

CORRESPONDENCE.

HUMAN FOOT-PRINTS IN STRATIFIED ROCK.

Messrs. Editors:

NEAR the mouth of the Little Cheyenne River, in Dakota Territory, there is a rock on which are some curious indentations. The rock lies on the north slope of a bowlder-covered hill, and is itself an erratic. It is about twelve feet long by seven or eight feet wide, and rises above the surface of the ground about eighteen inches. Its edges are angular, its surface flat, and it shows but little, if any, effect of ice-action. It appears to be magnesian limestone, and its size and whiteness make it a conspicuous object.

On the surface, near the southeast corner of it, is a perfect foot-print as though made by the left, moccasined foot of a woman, or boy of, say, fourteen years. The toes are toward the north. The indentation is about half an inch deep. About four and a half feet in front of it and in line with it, near the middle of the rock, is a deeper indentation made with the *right* foot, the heel being deeper than the rest of the foot. And again, about five and a half feet in front of this, and in line with both the others, is a third foot-print, this time with the *left* foot.

The three foot-prints are of the same size, and are such as would apparently be made by a person running rapidly. The foot-print of the right foot is an inch deep at the heel, and three quarters of an inch at the ball. The third foot-print is about three quarters of an inch in depth. In all three the arch of the instep is well defined, and the toes faintly indicated. The rock is hard, and not of uniform texture, having vein-like markings about a quarter of an inch wide running through it, which, weathering harder than the body of the rock, present slightly raised surfaces. *This difference in the weathering of the rock is the same in the bottom of the foot-prints as on the surface of the rock.*

From Mr. Le Beau, a "squaw-man," who has lived in that region for twenty-six years, I learned that it is known to the Indians as a "medicine"-rock, and that they worship it. He says that none of the present Indians know anything of the origin of the foot-prints. A town has been recently started within half a mile of it, called Waneta, and white children playing about it have found numerous beads and other trinkets, probably placed there as offerings.

I had heard of the rock several weeks previous to my visit, and expected to find either the work of nature with only a fancied resemblance, or the rude sculpturing of the Indians. The uniformity in size and direction discredits the former view, as the difference between the foot-prints seems to make the latter doubtful; and the *possibility* of the foot-prints having been made when the material of which the rock is composed was in a soft state presents itself as the best solution of the problem.

I trust that this communication may lead to its investigation by those competent to decide the matter.

Very truly yours,

HERBERT P. HUBBELL.

WINONA, MINNESOTA, *September* 10, 1883.

ASTHMA AND ITS TREATMENT.

Messrs. Editors:

YOUR "Monthly" for September contains an article by Felix L. Oswald, M. D., on "Asthma." For many years I was a martyr to that distressing complaint, and know its character and symptoms from personal experience. Naturally, I have also gathered, from others who were similarly afflicted, results of their experience, to say nothing of what I have read in medical works on the subject. My own experience, and that of all whom I have known, is so different from what Dr. Oswald writes, that I am impelled, for the sake of many who may receive great injury, and perhaps even lose their lives by following his extreme doctrine, to write to you in criticism of what he has written.

There are many errors of statement in his article. He says "the most frequent proximate cause is violent mental emotion—fear, anxiety, and especially suppressed anger." I do not dispute that any one of these may cause asthma, but among the proximate causes that are far more frequent are an ordinary cold, a damp pillow, an ill-ventilated, stuffy room or berth, a severe attack of indigestion. Indeed, as an asthmatic attack generally comes on in the early morning, the patient waking in a semi-nightmare to find the attack already begun, it is after a period of rest rather than passion or mental excitement that it supervenes.

"Asthma," he says, "is a *warm-weather* disease." Perhaps it may be with some. There is a great variety in asthmatic cases. Some are better in cities, some in the country. There are no two cases alike in all their features. So far from asthma being a

warm-weather disease, and "*June* being *par excellence* the asthma-month of the year," my experience goes to show that the worst months are those in which the vegetation is decaying—September, October, and November.

Now, as to the remedy which our author recommends—cold water. I would like to apply his own language on a previous page of his article to this, where he says: "Horse-back-riding is an approved cure for epilepsy, but during the progress of the fit the application of the specific might lead to strange consequences. Yacht-sailing in a storm would be a bad way of curing sea-sickness, though it diminishes the danger of future attacks."

So it is with cold water as a cure for asthma. "A plunge-bath into a pond or tub of water" would indeed be a terrible remedy for a person afflicted with a severe asthmatic spasm. No person of adult years in such a condition would think of such a remedy, for its consequences might be fatal. The shock of such treatment would infallibly increase the spasm and greatly intensify the suffering. The patient instinctively feels this, and knows that he can endure only the most soothing and gentle treatment. Therefore there is no danger to any *adult* asthmatic in reading such advice. But parents or unskilled medical men might be misled by this authoritative statement as to the cold-water remedy, and might subject children to it with a refinement of brutality which they happily would be ignorant of, but which Dr. Oswald certainly ought to know better than to recommend.

Imagine the poor sufferer, propped in a chair, livid and gasping for each imperfect breath, unable to speak, fearful of the slightest motion, a terrible strain pressing on heart, brain, and nerves, and think of a plunge cold bath in such a case. Yet our Doctor says "it is the most reliable remedy." Certainly he, for one, has not been an asthmatic.

If this criticism has only the effect of making parents or physicians hesitate before adopting such cruel remedies with children (there is no fear of adults permitting it), my main purpose in writing it will be fulfilled.

Our author also condemns the use of the ordinary alleviations in asthmatic attacks. There is some truth, doubtless, in what he says on this subject. Still, they are of the greatest value. A traveler, for instance, who is free from asthma at home, stops at a close country inn, and contracts an attack of asthma. Then the remedies which are usually prescribed—perhaps stramonium, perhaps coffee, or perhaps niter-paper fumes—relieve rapidly, and enable the traveler to proceed, whereas without them the spasm might last for days. These remedies act as helps, and the system has a surplus of strength sufficient to repair the slight damage caused by them. They help in the time of need. They act as brandy does to a frozen mountaineer; and, if a mistaken medical philosophy is going to deprive the suffering asthmatic of these invaluable aids and reliefs, it ought to be combated and exposed. As well say that surgical operations should be conducted without chloroform or ether, because the effect of those anæsthetics is harmful, as to say that the blessed relief which nature's herbs provide should not be used in case of an asthmatic emergency.

Whatever may be Dr. Oswald's merits as a physician, his paper on asthma, judged from the standpoint of a campaigner in that complaint, is not sufficiently correct or judicious to be a safe guide for the physician or the sufferer. W. B. CROSBY.

NEW YORK, *September* 15, 1883.

Messrs. Editors:

FROM the symptoms described by Mr. W. B. Crosby, I suspect that his affliction is not chronic asthma, but the *dyspnœa* which sometimes accompanies a latent tubercular diathesis, and which, in its spasmodic form, is generally aggravated by catarrh. Asthma, like hay-fever, is chiefly a warm-weather disease; still, if Mr. Crosby's trouble is not *confined* to the end of the year, I believe I can reconcile his experience with my observation on the secondary causes of the disorder, viz., that the symptoms often ascribed to the effect of a vegetable pollen "are probably a consequence of the relaxing influence of the first warm weather, for in midwinter a single warm day, following upon a protracted frost, may produce symptoms exactly resembling those of a hay-catarrh" ("Popular Science Monthly," p. 606). Your correspondent suspects a morbific agency in the decay of the autumnal vegetation, and, in America at least, the October frosts, when the falling leaves expose a vast area of woodland-soil, are almost yearly followed by a return of warm weather. I make no doubt but annual asthmas are often supplemented by Indian-summer attacks. What Mr. Crosby says about the causal connection of asthma and *indigestion* was mentioned in other words on p. 610 ("Popular Science Monthly"): "There is a curious correlation between asthma and *close stools;* they come and go together."

Mr. Crosby is probably not less correct in his statement that his asthmatic spasms "generally come on in the early mornings, the patient waking in a semi-nightmare to find the attack already begun," and his description does not materially differ from mine, that, "after rolling and tossing about till relieved by that form of sleep which the Germans call 'Ein-dämmern'—the patient

is almost sure to start up with a feeling of strangulation" ("Popular Science Monthly," p. 611). But even in such cases the proximate cause can generally be traced to some occurrence of the preceding day; indeed, most sufferers from chronic asthma know from the experience of their waking hours what the next night may be expected to have in store for them.

I do not suppose that your correspondent, whose letters bespeak him an intelligent observer, can be a dupe of the vulgar fallacy which mistakes a low temperature for the cause of "colds" and catarrhs; still, it is evident that he overrates the danger of its employment as a "remedial agent." For one life lost by the abuse of cold water, a million have been lost by the abuse of drugs. Dr. Carl Bock, whose manual of health, "Das Buch vom gesunden und kranken Menschen," is a standard (though entirely *non-systemic*) work on practical hygiene, recommends a sponge or shower-bath among the safest antispasmodics (c. "Angor pectoris, or Asthma," p. 502). It is well known that the paroxysms of yellow fever and cognate diseases decrease the intoxicating effects of alcoholic stimulants, and hydropathists have repeatedly called attention to the fact that under similar circumstances the dreaded nervous shock of a cold douche is partly neutralized by the conditions of the disease itself, and acts only as a tonic in the best sense of the word; and, since Dr. Koch's discovery, no modification of accepted medical theories has excited more attention than the successful application of cold baths to the treatment of typhoid fever. For a practical illustration of their efficacy in severe cases of spasmodic asthma, I can refer Mr. Crosby to the experience of two of my correspondents, Mr. Otto Schreiner, of Jacksonville, Florida, and Dr. H. D. Warner, of Reliance, Polk County, Tennessee. After stating his personal experience, Dr. Warner adds, "Priessnitz," the founder of hydropathy," would become the patron-saint of asthma-patients, if they could rid themselves of the superstitious dread of cold water and give the plan a fair trial."

Stramonium (*vide Datura* in "American Cyclopædia," or any medical or pharmaceutical compend) is one of the strongest narcotic poisons, and in its physiological action resembles belladonna and henbane, producing "dryness of the throat, active delirium, dilatation of the pupils, and a rapid pulse. Death may occur with coma and convulsions." And such remedies Mr. Crosby proposes to apply to patients who "can endure only the most soothing and gentle treatment"! It is true that the action of the drug is somewhat modified by the abnormal condition of the system; still, its after-effects are perceptible for days; while those of cold water are limited to the *dread* of direful consequences, and one or two test-experiments will rarely fail to remove that objection, which is, after all, only a specialized form of the same traditional fallacy which in winter ascribes fatal consequences to an open window, but risks the sickening effluvium of an unventilated bedroom; which in warm weather dreads a draught of cold water, but trusts its life to the tender mercies of the liquor-mixer. Besides, the asthenia of an asthma-spasm is an eclipse, a temporary paralysis, rather than an exhaustion of the vital energies; and the shiver of a cold douche, instead of complicating the afflictions of the patient, relieves them by breaking the spell of the obstruction. Of course, neither stramonium nor cold water alone can reach the cause of the disease, which must be removed by an invigorating regimen—out-door life, wholesome food, and persistent continence; cold water, however, is at least an adjuvant means to that end, while the repeated use of narcotic drugs never fails to impair the tone of the nervous system, and thus directly tends to perpetuate an asthenic diathesis.*

But I fully agree with your correspondent that asthma is the most capricious disorder of the human organism, and that its study can never be exhausted. Most of his observations can be readily reconciled with the doctrine of my treatise; but, even in as far as they may represent the record of an exceptional experience, I consider them, on the whole, a valuable contribution to the pathology of the disease.

F. L. Oswald.

ANIMAL FRIENDSHIPS.

Messrs. Editors:

An article on animal friendships, which appeared not long since in "The Popular Science Monthly," reminded me of a remarkable instance that came under my own observation a short time ago.

While on a visit to a farmer in a neighboring county, I was surprised to see a magnificent, full-grown wild-turkey wandering around with the fowls in his barnyard. On watching the turkey, I was still more surprised to notice that she followed particularly a large rooster; the two seemed to be on excellent terms, and frequently strayed off from the main flock together. Inquiring of the owner, I learned the following facts: Two of his children found a few wild-turkeys' eggs in the forest and brought them home, placing them under a domestic turkey, with other eggs, to hatch. Three of the wild-turkey eggs hatched, and two of the chicks lived to grow up, but soon

* "China tobacco" and niter are hardly less objectionable. Only three weeks ago Charles H. Codman, the well-known liberal and political economist, died from the effects of inhaling niter-fumes. (*Vide* p. 148 in Boston "Index" of September 27, 1888.)

betrayed an evident dislike for the domestic turkeys, the one before mentioned showing a warm regard for the rooster, which was evidently reciprocated. When this one became fully grown, the children traded it off to a neighboring boy who resided about three miles distant in the woods, but on the following day the turkey appeared at its old home and immediately sought out its friend the rooster. It was returned to the neighbor, who finally found it impossible to keep his new possession, and so the bargain had to be annulled, and rooster and turkey were allowed to peacefully enjoy each other's companionship. E. M. S.

SPRINGFIELD, MISSOURI, *October* 22, 1883.

EDITOR'S TABLE.

DEAD-LANGUAGE STUDIES NECESSARILY A FAILURE.

WE last month cited conclusive testimony that, *as a matter of fact*, classical studies are a general and notorious failure; we now propose to look a little into the *causes* of that failure. The partisans of the system have a ready reason for so much of it as they have not the assurance to deny. They admit that the dead languages may partially fail because they are poorly taught.

It is significant that this complaint of bad classical teaching has been made for hundreds of years. The indictments of the system on this score by eminent men would fill a big book. But why, then, have not the sorely-needed reforms been carried out? The subject is surely important enough, and has been prominent enough to enforce attention to it. It has occupied the scholarly talent of generations; yet, where the system has been tried longest, the best minds have still cried out against the unbroken experience of failure, notwithstanding all attempts to reform the bad practices. Two hundred years ago, the mode of studying the dead languages was sharply condemned by John Milton, who thus wrote: "We do amiss to spend seven or eight years in scraping together so much miserable Greek and Latin as might be learned otherwise easily and delightfully in one year." Milton believed in reform, and had the most sanguine hope from a better system, which would do more even for dunces than the prevailing method could do for brighter minds, and he gives to his expectation the following quaint and vigorous expression: "I doubt not that ye shall have more ado to drive our dullest and laziest youth, our stocks and stubs, from the infinite desire of such a happy nurture, than we have now to hale and drag our hopefullest and choicest wits to that asinine feast of sow-thistles and brambles which is commonly set before them as the food and entertainment of their tenderest and most docible age." And, after a couple of centuries of progress, what is the outcome? We still hear everywhere that the dead languages fail, because they are taught by obsolete and irrational methods, and it is stoutly claimed that all we need is their reformation.

But what mystery is there about these languages that their study should prove the great chronic scandalous failure of higher education, age after age? There can be no reason in their constitution or peculiarities that should necessitate any such result. There has been a thousand times more practice in teaching them than in teaching any other languages; the work of learning them is of the same kind as that of learning other languages, and they are said, moreover, to be the most perfect forms of speech, and in that respect would seem to have advantages over other languages. There is nothing exceptional in the processes of their study. The meanings and relations of words have simply to be acquired, so that they can be used for the expression of thought.

Dictionaries, grammars, literary models abound, and experienced teachers superabound. And yet, with all these facilities, the study of dead languages has been the one pre-eminent and historic failure of the so-called liberal education. There is more repulsiveness in it and more hatred of it than any other kind of study—mathematics not excepted. There have been more flogging, bullying, and bribery resorted to as incentives to classical study than to all other studies whatever. Both in England and in Germany the system has long maintained an exclusive ascendency by a barbaric discipline on the one hand, and on the other by all kinds of prizes, honors, and emoluments that could stimulate selfish ambition, and which have been jealously withheld from modern studies. With all these factitious stimulants to classical study, its failure has been so notorious that we can not attribute it to any accidental defects in the modes of its teaching. Nor can these defects be so readily repaired, for no possible reform in the modes of studying the dead languages can alter their relations to modern thought. It is here that we find the open secret of their failure.

Professor Cooke struck the keynote of this discussion when he remarked, in his article on "The Greek Question," in the last "Monthly": "A half-century has wholly changed the relations of human knowledge," and "the natural sciences have become the chief factors of our modern civilization." This change in the relations of knowledge, by which the sciences have become the great intellectual factors of civilization, has necessarily brought with it a corresponding revolution in education. For the new knowledge did not originate by the old methods of study; it came by new exercises of the mind, as much contrasted with previous habits as the greatness of its results is contrasted with the barrenness of the traditional scholarship. The old method occupied itself mainly with the study of language; the new method passed beyond language to the study of the actual phenomena of nature. The old method has for its end lingual accomplishments; the new method, a real knowledge of the characters and relations of natural things. The old method trains the verbal memory, and the reason, so far as it is exercised in transposing thought from one form of expression to another. The new method cultivates the powers of observation and the faculty of reasoning upon the objects of experience so as to educate the judgment in dealing with the problems of life. The old method left uncultivated whole tracts of the mind that are of supreme importance in gaining a knowledge of the actual properties and principles of things which are fundamental in our progressive civilization; the new method begins with the systematic cultivation of these neglected mental powers. The old method has yielded to the world long ago all that it is capable of giving; the new method has already accomplished much, but it has as yet yielded but comparatively little of what it is capable of giving when it becomes organized into a perfected system of education. It is this new scientific method, based in nature, fortified in the noblest conquests of the human mind, and full of promise in its future development that has become the rival in these days of the old system of dead-language studies. They have failed because they can not hold their ground against the new competitor.

The classics are constantly defended because of their boasted discipline, yet they have declined because of the growing sense of the weakness and inferiority of the mental cultivation they impart. They are accomplishments for show, rather than solid acquisitions for use. The study of words, the chief scholarly occupation, is mentally debilitating, because it leaves unexercised, or exercises but very imperfectly, the most impor-

tant faculties of the mind—those which can only be aroused to vigorous action by direct application to the facts of the phenomenal world. That classical studies fail here has been long conceded. Dr. Whewell declares that "mere classical reading is a narrow and enfeebling education," and Sydney Smith speaks of "the safe and elegant imbecilities of classical culture." A system characterized by feebleness and imbecility in its mental reactions is no preparation for dealing with the stern problems of modern life. More and more it is felt to be out of place, and is consequently neglected. No kind of culture degenerates so readily into stupid mechanical routine as that of language. Professor Halford Vaughn thus characterizes the effects upon the mind of our excessive addition to lingual pursuits: "There is no study that could prove more successful in producing often thorough idleness and vacancy of mind, parrot-like repetition and sing-song knowledge, to the abeyance and destruction of the intellectual powers, as well as to the loss and paralysis of the outward senses, than our traditional study and idolatry of language." Very properly may it be said that our inordinate study of language is an idolatry of which the blind devotion to Greek is but the fetichistic form. The cause of the failure of the classics is, therefore, not because a thousand years of experience with them has failed to give us good methods of study, but because, in the competition with modern sciences, as Canon Farrar remarks, "they have been weighed in the balance and found wanting."

We have, therefore, to regard the educational failure of the dead languages as a result of the progress of the human mind, and therefore as a normal and inevitable thing. They hold their position against the advancing knowledge of the age through the power of tradition, through the blind veneration of things ancient, because they represent a conventional culture, and are conserved by old and wealthy institutions. There is, besides, a good deal of money in the classics, which is not to be overlooked when we wish to account for the tenacity with which they are maintained. Professor Gildersleeve, in a recent article "On Classics in Colleges," in the "Princeton Review," takes a very hopeful view of their continued ascendency because, among other reasons, "the vested interests of classical study are, even from a mercantile point of view, enormous. Not only teachers, but bookmakers, have a heavy stake in the fortunes of the classics, and the capital involved in them reminds us of the pecuniary hold of paganism in the early Christian centuries." Through the operation of such causes, the classics will undoubtedly linger long in the universities, but that they must yield to the pressure of modern knowledge is inevitable; and the indications that they are yielding are apparent on every hand.

But if the failure of dead-language studies be thus necessary for the causes assigned, can they then be said to succeed, even if the student accomplishes everything proposed? Is it so entirely clear that he who faithfully masters them is not worse off than he who slurs and neglects them? The presidents of our colleges tell us that the students of Latin and Greek actually succeed, even when they seem to fail; but may it not be said with more truth that they fail even when they seem most to succeed, so that it is hardly a paradox to say the greater the success the greater the failure? If classical studies are behind the age and out of place, then the greater the proficiency the worse the displacement. The hope is on the idlers at the tails of their classes, as they stand a chance of learning something else, while the poor victim of classical infatuation, with his cultivated contempt of everything useful, comes out the most pitiable of all failures. Hap-

pily we see in this country but very few of the blooming specimens of what the system can do, because our classical standards in the colleges are not high, and because the pressure of other subjects is not to be entirely resisted. But observation gives abundant assurance that no man is so disqualified for any desirable use, so irremediably helpless in the struggles of actual life, as he who has attained to the high classical ideal, and made himself at home in the literatures of Greece and Rome. The following sketch of a successful university product appeared a few years ago in the London "Times":

"Common things are quite as much neglected and despised in the education of the rich as in that of the poor. It is wonderful how little a young gentleman may know when he has taken his university degrees, *especially if he has been industrious, and has stuck to his studies.* He may really spend a long time in looking for somebody more ignorant than himself. If he talks with the driver of the stage-coach, that lands him at his father's door, he finds he knows nothing of horses. If he falls into conversation with a gardener, he knows nothing of plants or flowers. If he walks into the fields, he does not know the difference between barley, rye, and wheat; between rape and turnips; between lucern and sainfoin; between natural and artificial grass. If he goes into a carpenter's yard, he does not know one wood from another. If he comes across an attorney, he has no idea of the difference between common and statute law, and is wholly in the dark as to those securities of personal and political liberty on which we pride ourselves. If he talks with a county magistrate, he finds his only idea of the office is, that the gentleman is a sort of English sheik, as the mayor of the neighboring borough is a sort of cadi. If he strolls into any workshop, or place of manufacture, it is always to find his level, and that a level far below the present company. If he dines out, and as a youth of proved talents, and perhaps university honors, is expected to be literary, his literature is confined to a few popular novels—the novels of the last century, or even of the last generation—history and poetry having been almost studiously omitted in his education. The girl who has never stirred from home, and whose education has been economized, not to say neglected, in order to send her own brother to college, knows vastly more of those things than he does. The same exposure awaits him wherever he goes, and whenever he has the audacity to open his mouth. At sea he is a landlubber, in the country a cockney, in town a greenhorn, in science an ignoramus, in business a simpleton, in pleasure a milksop—everywhere out of his element, everywhere at sea, in the clouds, adrift, or by whatever word utter ignorance and incapacity are to be described. In society and in the work of life he finds himself beaten by the youth whom at college he despised as frivolous or abhorred as profligate. He is ordained, and takes charge of a parish, only to be laughed at by the farmers, the tradespeople, and even the old women, for he can hardly talk of religion without betraying a want of common sense."

Have we not here delineated the natural outcome of a method of instruction which, despising utility and disparaging modern knowledge, would, if strictly carried out, multiply incapables on every hand? Classical studies are theoretically predominant in most of our higher institutions of education. Could they be "successful," as it is maintained they may be and ought to be—that is, could they be pursued with the thoroughness necessary to gain the advantages claimed for them—what other effect would follow than to fill the community with weaklings, imbeciles, and good-for-nothings, of which the "Times" has portrayed for us a typical example? Such a "success" of the

classics would stop the progress of knowledge, and arrest the advance of civilization. The failure of dead-language studies is therefore a salutary result in the course of nature—a necessity, a blessing, and an occasion of thankfulness, rather than of regret and lamentation.

QUEER DEFENSES OF THE CLASSICS.

THEY played it rather rough on Lord Coleridge the other day in calling him out on the classical question at Yale College. To be sure, it was a great temptation to exploit so illustrious a man in behalf of a declining cause, especially just now when it is understood that they are somewhat sore at that venerable seat of learning at being pilloried as fetich-worshipers, on account of their devotion to dead languages. It looked a little like a put-up job, as President Porter called up the subject in his pleasant little opening speech, and Lord Coleridge acknowledged that he had been posted that very morning with reference to Mr. Adams's address attacking the curriculum for which Yale is especially distinguished. But it was a little cruel not to have allowed his lordship more time, so that he might at least have refrained from giving away his whole case. Lord Coleridge was reported as saying: "I have done many foolish things in my life, and wasted many hours of precious time; but one thing I have done which I would do over again, and the hours I spent at it are the hours which I have spent most profitably, and the knowledge thus gained I have found the most useful, and practically useful. From the time I left Oxford I have made it a religion, so far as I could, never to let a day pass without reading some Latin and Greek, and I can tell you that, so far as my course may be deemed a successful one, I deliberately assert, maintain, and believe, that what little success has been granted to me in life has been materially aided by the constant study of the classics, which it has been my delight and privilege all my life to persevere in. This is not said for the sake of controversy; still less is it said to an audience of American university young men for the purpose of appearing eccentric; but it is said because I believe it to be true, and I will tell you why. Statement, thought, arrangement, however men may struggle against them, have an influence upon them, and public men, however they may dislike it, are forced to admit that, conditions being equal, the man who can state anything best, who can pursue an argument more closely, who can give the richest and most felicitous illustrations, and who can command some kind of beauty of diction, will have the advantage over his contemporaries. And if at the bar or in the senate anything has been done which has been conspicuously better than the work of other men, it has, in almost every case, been the result of high education. I say high education, not necessarily classical, because every man can not have it. The greatest orator of my country at this moment, as he himself has often said, has 'only a smack of it.'"

But for the gravity of the occasion, and the dignity of those who figured in its proceedings, we should say that this was a little funny, and might query whether the noble lord had not been misreported in citing the greatest orator of England in connection with classical education. But there can be no mistake, for his lordship again remarks, "The man who has influenced his contemporaries the most is, generally speaking, the man of highest education" and he had previously said, "If John Bright comes here, you will know what English speaking is—you will know what English oratory is." Since the celebrated case of Balaam, who was sent for to prophesy one way, and, when it came to the pinch, went back on his employers, and prophesied in ex-

actly the opposite way, there has been no more conspicuous instance of incalculable waywardness in mental operations than was here furnished by the Chief-Justice of England. He might as well have broken into a eulogy of Napoleon Bonaparte before the Peace Society as to have named John Bright in Yale College in connection with dead-language studies. He was expected to applaud the ancient classical scholarship as the supreme incomparable means of bringing the human mind up to its highest power; and he did this by quoting a man as the most commanding orator of England who knew nothing about ancient scholarship, and who has achieved his distinction entirely by the study of the English classics. He came to eulogize the dead languages, and gave super-eminence to a man who knew nothing of either, and had devoted himself exclusively to the mastery of his vernacular speech. Lord Coleridge represented the intellectual accomplishments that give the highest advantage in the bar and the senate as fourfold. The highest education is exemplified by (1) "the man who can state anything best"; (2), "who can pursue an argument more closely"; (3), "who can give the richest and most felicitous illustrations"; and (4), "who can command some beauty of diction"; and he then pointed to the man of all England who possesses the traits in the highest degree, and who is confessedly only a smatterer in Latin and Greek. He commended classical education, but he referred to another education, not classical, which yields still higher results. Certainly, if the Yale boys turn this memorable occasion to its highest uses, they will be incited to tread in the path followed by the most distinguished orator of England, and, wasting little time upon the dead languages, will concentrate their main efforts in gaining a skillful and powerful control of the living language in which all their work is to be done.

The case of John Bright turns the tables upon the classicists. His example, like that of many other of our strongest men, proves the advantage of not squandering mental force over a wide field of lingual study. If the native speech, as an instrument of expression, is to be perfected, it must become an object of systematic, undivided cultivation. This is a dictate of common sense, and has been long understood. We dissipate our energies upon foreign tongues, and it is still as true as it was in the time of Dryden, that "the properties and delicacies of the English are known to few." The mediævals studied Latin because they had to make use of it. All learning was in Latin, and the language had to be acquired for practical purposes. Melanchthon, in 1528, made a report on churches and schools which became the basis in Saxony of a reformed education independent of Rome, and the example was followed in other German states. In this report it is recommended that "the children be taught Latin only, not German, Greek, or Hebrew. *Plurality of tongues does them more harm than good.*" In the very nature of the case, our craze for foreign languages, living and dead, must be at the expense of a perfected English. It has been well said that "the idea of training upon a foreign language had grown up in modern times. The Greeks did not train upon Persian or Scythian; they knew no language but their own." This is not only a fact of profound significance, but it is a crushing answer to the modern polyglot superstition. Everybody is recommended to study Greek because the language is so beautiful and perfect. Obviously the true lesson is that the Greeks made it so because they were shut up in it, and could give their whole power to its improvement. Granting the unapproachable perfection of Greek literature, and that the Greeks surpassed the world in philosophical acuteness, the invincible fact remains that they expended no ef-

fort in the study of foreign languages, and common sense declares that it was because of it. In his defense of the wholesale study of language, in the St. Andrew's address, Mr. Mill encountered this perplexing consideration, and his treatment of it was hardly more adroit than Lord Coleridge's reference to Mr. Bright. Having pointed out the numberless advantages of a knowledge of many languages, and then having to explain how the Greeks succeeded so remarkably without any such knowledge, he is driven to the shift of suggesting that these Greeks were a very wonderful people. He says, "I hardly know any greater proof of the extraordinary genius of the Greeks, than that they were able to make such brilliant achievements in abstract thought, knowing as they did no language but their own." From which we are to infer that if these clever Greeks could have had a couple of dead languages to train on, and three or four living languages to expand on, their achievements would have been simply prodigious! Another illustration of the power of fetich-worship to pervert the logical intellect.

On the whole, we can not think the Yale devotees have made much by trying to play off the Lord Chief-Justice of England against Mr. Adams on the classical question. They are very much in agreement. Mr. Adams said that he had forgotten his Latin and Greek; Lord Coleridge says that by calling in the aid of religion he has been able to hold on to his classical acquisitions. But Mr. Adams was before him, as shown by the title of his address, in recognizing the peculiar function of religion in the case.

We owe thanks to our classical friends for keeping the question in a lively condition. They have had much to say about the German experience with classical and scientific studies; we will see how much they make by that next month.

LITERARY NOTICES.

What Social Classes owe to Each Other. By William Graham Sumner, Professor of Political and Social Science in Yale College. New York: Harper & Brothers. Pp. 169. Price, 60 cents.

This little volume has exceptional claims upon the attention of thinking people. It is not of the current order of social science literature, but is rather a trenchant protest against its prevailing spirit, and an able attempt to substitute the scientific for the sentimental mode of studying the relations of men in society. Professor Sumner finds a very loose state of thinking in regard to social obligations, their grounds, and their extent, what people owe to each other, and what they expect from each other, and he shows very clearly that from erroneous views upon these subjects spring a large number of the worst evils of the social state.

The general object of beings who recognize evil as something to be avoided, and good as something to be sought, and who look forward to ends to be secured and work for the accomplishment of these ends, is undoubtedly to make things better, but how to do this it is by no means so easy to determine. The most conflicting projects are offered for the attainment of the end, and the discords of opinion as to what things are socially best show that ignorance, prejudice and passion have still a great deal to do with the subject. In any treatment of it, therefore, that can become instructive and helpful, the first thing is to get at the facts and call things by their right name. Professor Sumner has this unquestionable merit, that he refuses to be misled by words, and insists upon stripping off the illusions in which the subject is shrouded, and getting at the real things represented. This is not an agreeable task. It requires some courage to encounter an ignorant public sentiment which appropriates to itself the whole terminology of charity, benevolence, and sympathy for the poor and weak, and denounces as cold and hard-hearted all who do not share its sentimental views upon social questions. Professor Sumner comes in for a liberal amount of reprobation, the "New York Tribune," for example, saying that his book is characterized by "an insolent

dogmatism," and its critic declares that he "can not resist the feeling that our professor has a great contempt for the poor."

Professor Sumner is charged with contravening alike the dictates of Christianity and the impulses of humanity in the views he presents, but such a charge is clearly groundless. For, if anything is established by the widest experience, it is that Christian philanthropy and benevolent impulse require a good deal better guidance than they have hitherto had. Instinctive sympathy is not enough, and it is simply notorious that indiscriminate charity does more harm than good. The more the subject is looked into, the greater is the accumulation of proof that benevolence and generosity, if not exercised with intelligent caution, work widespread mischievous effects. What we need, therefore, is a clearer understanding of the principles of the subject; and he who helps us to these may claim to be the most truly Christian and humane, because he shows us how to secure the most permanently beneficent ends. In spite of the literary cant about "Gradgrind," and the "dismal science," what we want most urgently are facts and their rational interpretations. Professor Sumner has been accused of an unfeeling indifference to the trials of the helpless and unfortunate, and of recommending the hard and selfish policy of looking out for one's self and neglecting those who need assistance. But this is a wholly unjust imputation. What he demands is simply that aid shall be given with a good deal more discrimination than is customary, and only where the giver is certain that he will not make matters worse by his charity. He never says that men in society owe nothing to each other, but he is very decided in the conviction that no class owes to another class that which will injure it. What they owe to each other are mutual guarantees of the opportunity to earn, possess, and enjoy, and do the best for themselves without interference or impediment. He says:

"The only help which is generally expedient, even within the limits of the private and personal relations of two persons to each other, is that which consists in helping a man to help himself. This always consists in opening the chances. A man of assured position can, by an effort which is of no appreciable importance to him, give aid which is of incalculable value to a man who is all ready to make his own career, if he can only get a chance." But "the aid which helps a man to help himself is not in the least akin to the aid which is given in charity."

But it is best to let Professor Sumner speak more fully for himself, and we accordingly give some extracts from his book in another part of the "Monthly." We have to apologize to the author for the fragmentary representation of his thoughts, but the reader can repair that by getting the book.

FIRST ANNUAL REPORT OF THE BOARD OF CONTROL OF THE NEW YORK STATE EXPERIMENT STATION. For 1882. Pp. 156.

THE grounds of the station are situated near Geneva, and embrace one hundred and twenty-five acres. The object of the institution is understood to be to ascertain, verify, and group facts the knowledge of which shall assist the farmer in carrying on his business. Its duties also comprise the dissemination of information; and for this purpose the director has published weekly bulletins of the progress of the experiments which were sent to newspapers, to the directors of other stations, and to men identified with agricultural progress. Special effort has been made to instruct visitors, and every intelligent visitor has brought information of value to the station. The investigations have had a practical rather than a theoretically-scientific bearing. As represented in the report, they have had a wide scope, and involve an immense number of details.

FIFTH ANNUAL REPORT OF THE STATE BOARD OF HEALTH OF THE STATE OF CONNECTICUT. Hartford: Case, Lockwood & Brainard Company. Pp. 128.

THE report is for the fiscal year ending November 30, 1882. It includes several valuable papers on subjects of theoretical and practical sanitation. Among the most interesting topics discussed is that of the progress of epidemic and intermittent fever in Connecticut and other parts of New England, concerning which Dr. G. H. Wilson contributes a very suggestive paper, and the secretary's report embodies many valuable facts.

ANNUAL REPORT OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION, FOR THE YEAR 1881. Washington: Government Printing-Office. Pp. 837.

THE scale and magnitude of the work accomplished by the Institution have been greatly increased in comparison with the work of previous years, while the expenditures have not been augmented. The building for the National Museum has been completed and occupied, and a large proportion of its material has been provisionally arranged for instructive display. Suitable accommodations have been provided within it for the chemical laboratory. A considerable number of original researches have been undertaken under the direction of the Institution, among the most important of which were, perhaps, those in Alaska. The twenty-third volume of the "Contributions to Knowledge" has been published, and contains six treatises; and the twentieth and twenty-first volumes of the "Miscellaneous Contributions" contain three parts or memoirs each. A valuable work has been done by the Ethnological Bureau, under the direction of Major Powell, particularly in the line of Mr. Cushing's investigations among the Zuñis, and Mr. James Stevenson's among other Pueblo tribes. Other scientific enterprises with which the Institution is allied are noticed; and the report-volume itself embodies the results of a considerable amount of research in meteorology and allied subjects, astronomy, physics, chemistry, botany, zoölogy, and anthropology, with numerous special papers in the last-mentioned subject.

GOD AND CREATION. By ROBERT REID HOWISON. Richmond, Virginia: West, Johnston & Co. Pp. 578.

THE author of this work is a Presbyterian clergyman of Richmond, Virginia, who here deals with scientific as well as theological questions, bringing to aid him in his task the results of the thoughts and studies of years. Starting with the principle that belief in Eternal Being is a necessary result of human experience and of all thought on the origin of things, the question arises what is this Eternal Being? To the author it is not solely matter or solely spirit or mind, but—and this is what it is the avowed purpose of the book to maintain—it "consists in God, the Eternal Spirit, or Mind, immanent in and working upon eternal matter, and bringing out of it, in time, the best results that perfect wisdom, benevolence, and power can produce." This at once brings the doctrines of materialism into the discussion. "But as materialism necessarily denies the existence of a spiritual and personal God, and asserts itself as a rival and conflicting system of faith, of course its advocates can not be overthrown by appeal to the authority of Scripture. . . . If met at all, they must be met on the ground of unrevealed knowledge." A summary of the history of materialism and the materialists, from Democritus down, is given, and the conclusion is expressed that "Darwin, Huxley, Spencer, and Tyndall, have not advanced a step nearer to the construction of the universe without the aid of a spiritual intelligence than Lucretius did in his poem." The attempt is next made to show that the doctrine of creation out of nothing is not found in any of the canonical books of the Bible, nor in any authoritative Christian creed or confession of faith of a date older than A. D. 1500; and the idea of a creation in six days is dismissed as untenable. The atomic theory of the constitution of matter is reviewed, and declared not competent to account for the phenomena, and a counter-hypothesis is advanced, which is called the nomian theory, or the hypothesis of law, the substance of which is that "God is the Eternal Power, Force, and Cause, in the universe." The rest of the book is mainly theological, and the conclusion is reached, agreeably to the philosophies of Kant and Hamilton, that "a science of ontology in its full meaning is impossible to man," or that, though we know that spirit *is*, and that matter *is*, we do not know, and probably never will know, what is the essence either of spirit or of matter."

A NEW SCHOOL DICTIONARY OF THE ENGLISH LANGUAGE: On the Basis of the Latest Edition of the Unabridged Dictionary of JOSEPH E. WORCESTER, LL. D. Philadelphia: J. B. Lippincott & Co. Pp. 390. Price, 90 cents.

THE former edition of Worcester's "Elementary Dictionary" was published in 1835, and was revised and enlarged in 1860. So

many changes have been made of late in our language that it has been deemed expedient to supersede the old work by this essentially new one. Besides the vocabulary proper, it contains tables of words and phrases from foreign languages; of pronunciation of biographical, mythological, and geographical names; of abbreviations used in writing and printing; and of weights and measures, the metric system, foreign coins, etc.

HISTORICAL STUDIES. Edited by TITUS MUNSON COAN. New York: G. P. Putnam's Sons. Pp. 205. Price, 25 cents.

THIS is the fourth number of Messrs. Putnam's "Topics of the Time" series, and includes five essays, viz.: "Village Life in Norfolk Six Hundred Years ago," by the Rev. Dr. Augustus Jessopp; "Siena," by Samuel James Cappar; "A Few Words about the Eighteenth Century," by Frederic Harrison; "France and England in 1793," by Oscar Browning; and "General Chanzy," from "Temple Bar."

THE FACTORS OF CIVILIZATION, REAL AND ASSUMED; considered in their Relation to Vice, Misery, Happiness, Unhappiness, and Progress. Atlanta, Georgia: James P. Harrison & Co. Vol. i., Pp. 347.

THE second volume of this work, in which were considered the unhappiness arising from poverty and that arising from uncongenial pursuits and labor, was published some months ago, when in our review of it (see the "Monthly" for March, 1883, p. 711) we indicated the general character and scope of the work as a whole. In the present volume, which, though following the other in the order of time, is intended to precede it in logical connection, are discussed the unhappiness due to erroneous theological conceptions and doctrines; that arising from bad forms of government; and that arising from ignorance. Much attention is given to the doctrines of Mr. Henry George.

A HISTORY OF THE NEW YORK STATE TEACHERS' ASSOCIATION. With Sketches of its Presidents and Prominent Members. By HYLAND C. KIRK. New York: E. L. Kellogg & Co. Pp. 175.

THIS book aims to give an accurate account of such matters in the history of the Association as seem to be of the most importance, and of such as would present the work of the teachers in the advancement of education in the State. Summaries are given of the proceedings of each of the thirty seven meetings of the Association. Many of the biographical sketches are accompanied with portraits of their subjects, which, unless the artist's or the printer's work were better done, had better been omitted.

VERBAL PITFALLS. A Manual of 1,500 Words commonly misused. By C. W. BARDEEN. Syracuse, New York: C. W. Bardeen. Pp. 223. Price, 75 cents.

THIS work is intended to include all the words the use of which has been questioned by the numerous verbal critics whose works are current, to collate the verdicts of the different authorities, and estimate, where it is practicable, the weight to be attached to their views. A strictly alphabetical arrangement is adopted; and the indication is given, by distinctions in type, at the head of each article, whether the word in question is indefensible or in dispute, or whether it may be regarded as legitimate.

ASTRONOMY. By SIMON NEWCOMB, LL. D., and EDWARD S. HOLDEN, M. A. New York: Henry Holt & Co. Pp. 338. Price, $1.40.

THE present treatise is a condensed edition of the larger "Astronomy" of the same authors, from which some of the less essential details of practical astronomy and most of the mathematical formulas have been omitted. Some of the space thus gained has been utilized in giving a fuller discussion of the more elementary parts of the subject, and in treating the fundamental principles from various points of view.

FINLAND: ITS FORESTS AND FOREST MANAGEMENT. Compiled by JOHN CROUMBIE BROWN, LL. D. Edinburgh: Oliver & Boyd; Montreal: Dawson Brothers. Pp. 290.

DR. BROWN has undertaken, as rapidly as his means will allow, to publish a kind of library of forestry, to which this is the third contribution. The other two volumes, relating to forestry in England and in France, have already been noticed in our pages. The object sought in the publications is to produce popular technical treatises which

may be useful to students of forest science who have not access to the works quoted, by stating views that have been advanced and have required attention, and by citing statements bearing upon them in such form as to place readers in a position to work out for themselves the solution of problems raised. Much of the information was collected by the author during a journey in Finland and Scandinavia.

GOD OUT AND MAN IN: OR, REPLIES TO ROBERT G. INGERSOLL. By W. H. PLATT, D. D., LL. D., Rector of St. Paul's Church, Rochester, New York. Rochester: Steel & Avery. Pp. 320.

As the title of this book sufficiently indicates, it is a polemic on the various issues between infidelity and Christianity, and is lively and interesting, and as decisive as such works usually are. It is, of course, not a systematic treatise in defense of Christianity, but takes up many objections that are urged by unbelievers. The form of the discussion favors explicitness of treatment, and is attractive to the reader. Various of Mr. Ingersoll's statements, put forth in his books and in his published lectures, are taken up as texts, and commented upon and replied to generally briefly, but sometimes with amplification. Dr. Platt is familiar with the recent forms of controversy which have arisen through the progress of science and the later aspects of philosophy, and he makes free and effective use of the arguments and concessions of eminent representatives of what is called the agnostic or materialistic school. The attention which he has given to this aspect of modern religious controversy enables him to handle it with unusual ability, and imparts to his volume perhaps its strongest claim to the reader's attention.

A CORRECTION.

IN our notice of Spencer's "Cyclopædia of Descriptive Sociology," which appeared in the October "Monthly," there occurs a misleading statement which it is desirable to rectify. Part III of that work, devoted to "Types of Lowest Races, Negritto Races, and Malayo-Polynesian Races," carelessly represents that the Negritto races and the Malayo-Polynesian races were specified as races meant by the title "Types of Lowest Races." This is incorrect. The title is meant to indicate three separate groups, of which "Types of the Lowest Races," including Fuegians, Veddahs, and Damans, constitute only the first. The other groups do not fall within this category; the Malayo-Polynesians, various of them, being quite high races both in type and civilization. It is desirable to avoid error and confusion in this important gradation.

PUBLICATIONS RECEIVED.

The Classification, Training, and Education of the Feeble-Minded, Imbecile, and Idiotic. By Charles H. Stanley Davis, M. D. New York: E. Steiger & Co. Pp. 46.

Variations in Nature. By Thomas Meehan. Salem Press, Salem, Mass. Pp. 14.

Bureau of Education Circular: Proceedings of the Department of Superintendence, American Educational Association, 1883. Washington: Government Printing-Office. Pp. 81.

A Physician's Sermon to Young Men. By William Pratt. New York: M. L. Holbrook & Co. Pp. 48. 25 cents.

Das Studium der Staatwissenschaften in Amerika (The Study of the Political Sciences in America). By Dr. E. J. James. Jena: Gustav Fischer. Pp. 26.

The North-Atlantic Cyclones of August, 1883. By Lieutenant W. H. H. Southerland, U. S. Navy. Washington: Government Printing-Office. Pp. 22.

Transactions of the New York Academy of Sciences, December, 1882, and January, 1883. Pp. 36. The same, February and March, 1883. Pp. 32. Editor, Alexis A. Julien, School of Mines, Columbia College, New York.

Programme of Studies, No. 10 Gramercy Park, New York. Pp. 20.

Some Researches after Hæmoglobin. By Robert Saunders Henry, A. M., M. D., Charleston, W. Va. Pp. 7.

Quarterly Report, Bureau of Statistics, Treasury Department, relative to Imports, Exports, Immigration, and Navigation. For Three Months ending June 30, 1883. Washington: Government Printing-Office. Pp. 112.

Incineration. By John D. Beugless. New York Cremation Society. Pp. 16.

On the Present Status of the Eccentricity Theory of Glacial Climate, pp. 8, and On the Origin and Mode of Normal Faults, pp. 5. By W. J. McGee.

Ueber das galvanische Verhalten der Amalgame des Zinkes und des Cadmiums (On the Galvanic Behavior of the Amalgams of Zinc and of Cadmium). By William L. Robb, A. B. Berlin: Gustav Schade. Pp. 31.

The Sun changes its Position in Space. By August Tischner. Leipzig: Gustav Fock. Pp. 37.

Evolution of the American Trotting-Horse. By Francis E. Nipher. Pp. 6.

Notes on American Earthquakes. By Professor C. G. Rockwood, Jr., Ph. D., Princeton, N. J. Pp. 8.

Description of a New Hydrobiinoid Gasteropod from the Mountain Lakes of the Sierra Nevada. By Robert E. C. Stearns. Pp. 6.

Cholera a Disease of the Nervous System. By John Chapman, M. D. London: J. & A. Churchill. Pp. 16.

Latitude, Longitude, and Time. By J. Anthony Bassett. Syracuse, N. Y.: C. W. Bardeen. Pp. 42. 25 cents.

Horses: their Feed and their Feet. By C. E. Page, M. D. New York: Fowler & Wells. Pp. 150. 50 cents.

Dime Question-Books: Grammar, pp. 37; Arithmetic, pp. 32; Geography, pp. 40. Syracuse, N. Y.: C. W. Bardeen. 10 cents each.

United States Salary List and the Civil Service Law, Rules and Regulations. Washington, D. C.: Henry N. Copp. Pp. 141. 35 cents.

Prison Labor. Some Considerations in Favor of maintaining the Present System. By John S. Perry. Albany: Weed, Parsons & Co. Pp. 128.

The Treatment of Wounds as based on Evolutionary Laws. By C. Pitfield Mitchell. New York: J. H. Vail & Co. Pp. 29. 50 cents.

The Mounds of the Mississippi Valley Historically Considered. By Lucien Carr, Cambridge, Mass. Pp. 107.

Transactions of the Medical and Chirurgical Faculty of the State of Maryland, April, 1883. Baltimore: Isaac Friedenwald. Pp. 302.

Aperçu sur la Théorie de l'Evolution (Summary of the Theory of Evolution). By Dr. Ladislao Netto. Rio de Janeiro: Le Messager du Brésil. Pp. 22.

Questões Hygienicas (Hygienic Questions): Animal Mephitism. The Sewers of Rio de Janeiro and their Influence on the Public Health. Some Hygienic Counsels to the People. By Dr. João Pires Farinha. Rio de Janeiro: Typographia Nacional. Pp. 54.

Die Physik im Dienste der Wissenschaft, der Kunst, und des practischen Lebens (Physics in the Service of Science, Art, and Practical Life). By Dr. G. Krebs. Stuttgart: Ferdinand Enke. Part I. Pp. 112. 2 marks.

Beyond the Sunrise: Observations of Two Travelers. New York: John W. Lovell Company. Pp. 237. 20 cents.

King's Hand-Book of Boston. Cambridge, Mass.: Moses King. Pp. 360. $1.

Ancient Egypt in the Light of Modern Discoveries. By Professor H. S. Osborn, LL. D. Cincinnati: Robert Clarke & Co. Pp. 232. $1.25.

The Handy Book of Object-Lessons. By J. Walker. Philadelphia: J. B. Lippincott & Co. Pp. 129. $1.25.

Sea-Sickness: Its Cause, Nature, and Prevention. By William H. Hudson. Boston: S. E. Cassino & Co. Pp. 147. $1.25.

Chemistry: General, Medical, and Pharmaceutical. By John Attfield, F. R. S. Philadelphia: Henry C. Lea's Son & Co. Pp. 727. $3.

History and Uses of Limestones and Marbles. By S. M. Burnham. Boston: S. E. Cassino & Co. Pp. 392. $6. Illustrated.

Natural Philosophy. By Isaac Sharpless, Sc. D., and G. M. Phillips, A. M. Philadelphia: J. B. Lippincott & Co. Pp. 342.

A Natural History Reader, for School and Home. Compiled and arranged by James Johonnot. New York: D. Appleton & Co. Pp. 414. $1.25. Illustrated.

Animal Life. By E. Perceval Wright, M. A., M. D. London, Paris, and New York: Cassell, Petter, Galpin & Co. Pp. 618. $2.50. Illustrated.

Bulletin of the United States Fish Commission. Vol. I, 1881, pp. 466; vol. II, 1882, pp. 467. Washington: Government Printing-Office.

The English Grammar of William Cobbett. Revised and annotated by Alfred Ayres. New York: D. Appleton & Co. Pp. 254. $1.

United States Geographical and Geological Survey of the Territories: Wyoming and Idaho. By F. V. Hayden. Part I, pp. 809; Part II, pp. 503; both with numerous Plates. Also a volume of Maps and Panoramas. Washington: Government Printing-Office.

Mineral Resources of the United States. By Albert Williams, Jr. Washington: Government Printing-Office. Pp. 813.

The Law of Heredity. A Study of the Cause of Variation and the Origin of Living Organisms. By W. K. Brooks, Associate in Biology, Johns Hopkins University. Baltimore: John Murphy & Co. 1883. Pp. 336.

Cumulative Method for Learning German. By Adolph Dreyspring. New York: D. Appleton & Co. Pp. 253. $1.50.

POPULAR MISCELLANY.

Glacial Theories at the American Association.—Topics connected with the glacial theory received much discussion at the Minneapolis meeting of the American Association. In his paper on "The Life History of the Niagara River," Mr. Julius Pohlman held that the falls had no part in excavating the gorge below the whirlpool; but that, Lake Ontario subsiding slowly, no waterfall was formed at its entrance, and the lower part of the gorge was worn out by the river as a rapid in an old shallow valley, till at the whirlpool this path met the ancient river-valley, while it was along that valley only that the falls receded to their present site. In a paper on "Glacial Cañons," W. J. McGee, of Salt Lake City, suggested that the formation of the cañons could be accounted for by presuming that typical water-cut cañons were temporarily occupied by glacial ice, which would convert them from a V into a U shape, and that their features do not "necessarily imply extensive glacial excavation, or indicate that glaciers are superlatively energetic engines of erosion." In his paper on the extent, character, and teachings of the ancient glaciation of North America, Professor Newberry maintained that—1. Glaciers covered most of the elevated portions of the mountain-belts in the far West as far south as the thirty-sixth parallel, and in the eastern half of the continent to the fortieth parallel of latitude. 2. The ancient glaciers, which occupied the area above described, were not produced by local causes, but were evidences of a general climatic condition. 3. They could not have been the effect of a warm climate and an abundant precipitation of moisture, but were results of a general depression of temperature. Having stated his objections to the iceberg theory, Professor Newberry added that "the record of the ice period on our continent is far more impressive and extensive than it has been represented. The phenomena were due to an extraneous and

cosmical cause, not to anything local or even telluric. The question here passes from the geologist, and must be addressed to the astronomer." In another paper, on "The Eroding Power of Ice," Professor Newberry reiterated these views, and maintained, besides, in answer to objections, that "ice has a great, though unmeasured and perhaps immeasurable, eroding power; and that, in regions which they have occupied, glaciers have been always important and often preponderating agents in effecting geological changes." He supported his views with citations from his own extended studies of glacial action in the Alps and in many different regions of the United States and Canada. G. F. Wright, of Oberlin, Ohio, pointed out, in a paper on the "Result of Explorations of the Glacial Boundary between New Jersey and Illinois," that "the signs of glaciation cease where there is no barrier to account for their cessation, and where no barrier ever could have existed, such as must be supposed if the so-called glacial phenomena are the product of floating ice." To the question, Why is the boundary of the glacial area so crooked? the author replied, assigning, as a principal cause, aside from differences of level, the probability that unequal amounts of snow fell over different regions of the north, and this snow became very unevenly extended in its subsequent flow over the surface. A little reflection, he added, "will show that the glacial theory will not make extravagant suppositions as to the amount of ice required." In the general discussions of the subject, Dr. Dawson objected to the loose significance with which the term "moraine" has been used, and especially to the definition of it as "detrital matter heaped up by the forcible mechanical action of ice"; and pointed out that such a definition would certainly include work which was not performed by land-glaciers. Major Powell called attention to the fact that wholly different agencies, each acting in its own way, produced a class of geological features that went under the general name of "terraces." We have sea-beach terraces, lake-shore terraces, and yet another class of terraces exceedingly common in the Rocky and Cascade Mountains, due to a different cause from the others.

Parental Rights and the Gens among the Omahas.—Alice C. Fletcher, of New York, gave, at the recent meeting of the American Association, a paper on the laws and privileges of the *gens*, among the Omaha Indians. A child who has lost its father or mother is considered an orphan. Its particular place is gone, and it passes into the *gens*. If it is the father who dies, the mother loses all maternal rights. Each child, unless of very tender age, will be separated from the mother, and will go into the family of some one of the father's relatives. It may thereafter be claimed as his own child by the male head of the family to which it has been allotted. This separation of her children from a widow is permanent. She usually marries again, and in that event is not burdened with her offspring by previous husbands; but, if she remains unmarried, she is expected to work for the family that has adopted her children, rather than for the children themselves. The women are not wanting in affection for the children of whom they are bereft; but the separation is looked upon as a matter of course, and none of the interested parties regard it as a grievance, or even as a hardship.

Tarantula-Bites and the Dancing-Cure.—The tarantula, that gigantic spider of supposed very poisonous qualities, is native in Italy, and in the neighborhood of Tarento, whence its name is derived. Its bite and sting have been supposed to be extremely painful, and to produce a periodical derangement, manifesting itself in various ways. The affected persons were fabled to be attacked with a kind of compulsion to dance, which was called, after its cause, *tarantismus;* and real benefit, in the shape of a dilution of the poison, and a weakening of its effects, was supposed to accrue from subjecting the bitten person to a violent exercise of dancing. The doctors regarded the tarantismus as a kind of hypochondria, to which the women of Southern Italy were peculiarly subject, and some had prescriptions of particular kinds of music and special dances for its cure. Some held that different kinds of music should be prescribed to different persons, according to their character and temperament. Possi-

bly, however, a play upon names is connected with these conditions; and the dance called the *tarantella*, which is in great favor in Italy, may have derived its name in the same way as the great spider, simply from the fact that it is indigenous to the Tarentine province. The tarantula insect will bite, like any spider, when it is trodden upon; but that its bite is more dangerous than the sting of the hornet has not been proved. It is still customary in Apulia to make one dance who thinks he has been bitten by a tarantula. Waldemar Kaden relates that he was disturbed once by the noise of music and dancing, and that looking out he saw a youth, who was supposed to have been bitten while asleep in the field, going through the performance. The poor fellow was in the center of a circle of persons of all ages, held by the collar and arms by a strong peasant, and compelled to make the motions whether he would or not, while the crowd kept him excited with their shouts and clapping. The great point to be gained was to make him sweat, and, when this was brought about, the crowd rejoiced and gave him a glass of wine. The only mark on the youth was a red spot on the forehead that might have been a scratch. He had never seen a tarantula, and felt no pain or uneasiness, and was out at play an hour after the dance. Herr Kaden inquired of the people how many of them had been *tarantolati*. Not one of them had ever seen a tarantula, but they had all danced!—*Die Natur*.

The British Association.—The meeting of the British Association for 1883 was held at Southport, beginning September 19th. The President for the year was Professor Cayley, whose address on the "Obligations of Mathematics to Philosophy, and to Questions of Common Life," though it may have been to minds trained in mathematical modes of thought an admirable presentation of the subject, was far too abstruse to be capable of popular adaptation. Professor Ray Lankester opened the Biological Section with an address, urging greater liberality on the part of the state in encouraging the prosecution of biological studies. He drew a comparison decidedly unfavorable to England with what is done in this line on the Continent, especially in Germany, and, dwelling on the practical utility of such studies, declared that forty new biological institutes, requiring a capital sum of about two millions sterling, were needed in England. The section suggested the foundation of a marine laboratory at some point on the British coast, as a suitable object to which the surplus of funds anticipated from the Fisheries Exhibition could be applied. Dr. Gladstone's address in the Chemical Section was on "The Elements," and covered the history of the theories that have prevailed and the knowledge that has been gained on the subject; and showed that we have much yet to learn upon it. Among the more important papers read in this section was that of Professor A. W. Williamson, "On the Constitution of Matter." Professor W. C. Williamson, as Vice-President, gave in the Geological Section "a clear and concise exposition" of our present knowledge of the carboniferous flora. By the doctrine of evolution, there must have existed prior to the Devonian period, when the cryptogams were flourishing in wonderful grandeur, and distributed all over the earth, a vast succession of forms of vegetable life; yet hardly a vestige of this pre-Devonian flora has been unearthed; and it is clear that we are not yet in a position to construct a genealogical tree of the vegetable kingdom. Colonel Godwin-Austen addressed the Geological Section on the orography and geology of the Himalaya Mountain system; and Mr. Trelawney Saunders explained the scheme for connecting the Mediterranean with the Red Sea by means of a navigable canal through the valley of the Jordan. A communication was received in this section from Mr. Stanley, advising the establishment of a British protectorate over the Congo. Mr. Pengelly, of the Anthropological Section, having the discoveries in Kent's Cavern as his subject, adduced new evidence in favor of the belief in glacial or even pre-glacial man. Professor Henrici, in the Mathematical Section, spoke of the position of the study of geometry in England. In the Mechanical Section, Mr. Brunlees, engineer, traced the growth of mechanical appliances for the construction and working of railways and docks. In his address he referred to the assistance Mrs.

Roebling had given her husband during the construction of the Brooklyn Bridge, which he characterizes as "honorable to the individual woman, to the energetic nation to which she belongs, and to the better half of the human race." In the Statistical Section was presented the final report of the Anthropometric Committee, which has been for several years engaged in collecting evidence as to the stature and other physical characteristics of the inhabitants of the British Isles. The evening lectures were on "Recent Researches on the Distance of the Sun," by Professor R. S. Ball; "Galvani and Animal Electricity," by Professor McKendrick, of Glasgow; and "Telephones," by Sir F. Bramwell. The next meeting of the Association will be held in Montreal, and the meeting for 1885 in Aberdeen.

The Study of our Sidereal System.—In his address before the American Association, on "The German Survey of the Northern Heavens," Professor William A. Rogers defined the present condition of knowledge regarding the proper motions of the stars and of the solar system in space. Struve concluded several years ago that the solar system was moving in a direction toward a point in the constellation Hercules, and Mädler has indicated Alcyone in the Pleiades as the probable center of the greater system of which it forms a part; but, "Biot in 1812, Bessel in 1818, and Airy in 1860, reached the conclusion that the *certainty* of the movement of the solar system toward a given point in the heavens could not be affirmed. . . . It must always be kept in mind that the quantities with which we must deal in this investigation are exceedingly minute, and that the accidental errors of observation are at any time liable to lead to illusory results. . . . It can not be affirmed that there is a sidereal system in the sense in which we speak of the solar system. . . . Admitting that the solar system is moving through space, can we at the present moment even determine whether that motion is rectilinear or curved, to say nothing of the laws which govern it?" The questions connected with these points, if solved at all, must be solved by a critical study of observations of precision accumulated at widely separated epochs of time. The first step in the solution has been taken in the systematic survey of the northern heavens undertaken by the [*Astronomische*] *Gesellschaft*, and in the survey of the southern heavens at Cordova by Dr. Gould. "The year 1875 is the epoch about which are grouped the data which, combined with similar data for an epoch not earlier than 1950, will go far toward clearing up the doubts which now rest upon the question of the direction and the amount of the solar motion in space; and it can not be doubted that our knowledge of the laws which connect the sidereal with the solar system will be largely increased through this investigation."

Ideas about Fossils.—Professor August Quenstedt gives in his "Petrefacten Kunde" a review of the hypotheses that have been advanced at different times concerning the nature and origin of fossils, and of the slow processes by which the true theory of the subject has been reached. The views of the ancients were crude enough, but among them were some more intelligent and nearer to the truth than any that were held during the middle ages. The crude speculations of the latter period survived down to an age of greater scientific enlightenment; and the time is not extremely remote when belemnites were regarded as thunderbolts, and other fossils were looked upon as sports of Nature, or as efforts of Nature to prepare in the bosom of the earth the material forms of bodies preliminary to their receiving the breath of life. At a later period the belief arose that the fossils were once actually living creatures, and had been destroyed by the flood; and, as recently as 1828, Buckland supported such a view in his "Reliquæ Diluvianæ." This author was one of the earliest cave-hunters, and believed that the bones found in the caves were those which had been washed into them by the Noachian deluge. With such views having held a footing in our own century, we have little right to be amused at those who, in the age of Scheuchzer and Leibnitz, thought the bones of the gigantic salamander (*Salamandra gigantea*) were the remains of an old human sinner destroyed in the flood. Even Leibnitz had no doubt that the remains of a mammoth which were found

near Quedlinburg belonged to the unicorn of the Bible. Because the Bible assigned extremely long terms of life to the antediluvian patriarchs, popular belief ascribed a gigantic size to the ancestors of the present human race; and parts of huge fossil skeletons were occasionally preserved in the churches as relics. Such a belief was already so extensive, even in the time of Empedocles, B. C. 450, that a mass of hippopotamus-bones found in Sicily was declared by the learned of the day to be the remains of the giants who fought against the gods. The Mohammedans believed that Adam was as tall as a palm-tree, or about sixty feet, and found a mound of corresponding size in Syria to answer for his grave. The academician, Henrien, in 1718, described Adam as thirty-eight and a half metres and Eve as thirty-seven metres high, and herein did not greatly disagree with St. Augustine. The former world was long believed to have been constructed on a much more gigantic scale than the present; and the opinion that the old order of things and organisms was vastly different from the existing one, and was subverted by a tremendous revolution, prevailed quite generally, till Lamarck and Cuvier pointed out the way to a more consistent theory.

Defective Hearing in School-Children.—Dr. Gellé, a French physician, has recently published an important paper on defects of hearing among school-children. Dr. Weil, of Stuttgart, a year or two ago expressed the opinion that about thirty per cent of the children in commercial schools, and ten per cent of well-to-do school-children, hear but imperfectly. Dr. Gellé, from the examination of fourteen hundred cases of deafness in schools, fixes the proportion of children thus affected at about twenty or twenty-five per cent of the whole number. The deficiency is most obvious in the case of the consonant-sounds, the very ones most essential to the understanding of what is said. Dr. Gellé observes that the range of hearing for a given sound diminishes outside the class-room, or even in a covered yard; that mistakes cease or diminish as the distance of the teacher from the pupil is lessened; and that deafness increases with age. To make the conditions convenient for the hearing of the pupil, the teacher should take pains to place himself in the most favorable position and to articulate distinctly, and the size of the class-room should be adjusted according to the laws which limit the range of the most distinct hearing to about twenty-three or twenty-seven feet. The scholars, having been previously examined with reference to their hearing, should be arranged so as to place those most deficient in this respect nearest to the teacher.

Significance of the Aboriginal Mounds.—In the discussions of the Anthropological Section of the American Association, respecting the mounds, Dr. S. D. Peet divided those structures into five classes, as follows: 1. Emblematic mounds, built by hunters who worshiped animals. 2. Burial-mounds, a class mostly represented in Michigan, Illinois, and Minnesota. 3. Mounds which are probably the remains of the stockades of an agricultural people. 4. Village mounds—the remains of villages, and their high places for worship. 5. The peculiar mounds of the Pueblos and Aztecs. The emblematic mounds, having the forms of animals hunted, served a useful as well as a religious purpose, and were used as screens from behind which to shoot the animals that would pass along the game-drives between them. Of their religious significance, Dr. Peet's theory is, that the animals were supposed to be scattered about to guard the central sacrifice or altar mound. He has been led to this belief by observing that the altar-mounds are nearly always situated on high ground, overlooking a river, while the emblematic mounds are so disposed around the altar-mounds as to suggest the notion of guarding the latter.

The Singing-Sands of Manchester, Massachusetts.—A. A. Julien and Dr. H. C. Bolton presented a paper to the American Association, on the sands of the singing-beach, at Manchester, Massachusetts. On the beach, feldspathic rocks are intersected by numerous dikes of igneous rocks. The sonorous phenomenon is confined to particular parts of the sand, and is exhibited in areas to which closely contiguous ones are silent. The sound is produced by pressure, and may be likened to a subdued

crushing of low intensity and pitch, not metallic or crackling. It occurs when the sand is pressed by ordinary walking, increases with sudden pressure of the foot upon the sand, and is perceptible upon mere stirring by the hand, or even plunging one finger and removing it suddenly. It can be intensified by dragging wood on the beach. Somewhat similar phenomena have been observed in sands at various other places. The authors explain the phenomena upon the hypothesis that the sand, instead of being, as ordinarily, composed of rounded particles, is made up of grains with flat and angular surfaces. In the present instance, the plane surface of feldspar is apparent in many of the grains. Probably a certain proportion of quartz and feldspar grains is adapted to give the sound, while less or more of either component would fail of the result. It is concluded that the sound is produced either by the intermixture of grains having cleavage-planes, or of grains with minute cavities.

Use and Abuse of Check-Reins.—Bearing-reins, or check-reins, in the harness of horses, are useful and advantageous in their places and when rightly adjusted, but the instances in which they simply torture the animals that have to endure them are more conspicuous. In crowded streets, with high-mettled horses that run freely up to their bits, a well-fitted bearing-rein gives the driver a more thorough control of the animal that is valuable in avoiding collisions. A bolting horse, says the "Pall Mall Gazette," endeavors to get his head well down, so as to extend his neck, and thereby obtain a stronger purchase against the restraint of the reins; and if he is restrained by a bearing-rein, so that he can not lower his head below the level to which he would require to carry it for ordinary equilibrium in draught, his powers of bolting are greatly circumscribed, and if he is not excessively borne up he is not conscious that the rein is restraining him, and his powers of draught are not cramped. The fashion of coachmen is, however, to pull the bearing-rein up so tight that the horse's neck is cramped, and the animal is thrown into an unnatural and painful position, and is deprived of much of his power to draw the load that is intrusted to him. His feeling must be much the same as that of a man would be whose head was pulled back so that he would have to stand for hours looking up at the sky without being able to turn his eyes away, and had while in such a position to draw a baby-carriage. The fact that the adjustment of the rein is painful can be recognized from the unnatural attitude of the horse's neck, and from his fretfully tossing his head every few minutes to relieve himself, and shake off the foam from his jaws. "This tossing of the head and flecking of flanks, brisket, and harness with foam, seem to the coachman and to the unpracticed observer to be picturesque, and characteristic of high courage; to the experienced eye they betray that the animal is not only inconvenienced but is also pained by his position." Besides this annoyance, the animal thus tightly checked, being unable to throw the head reasonably forward when feeling his collar, can not utilize his natural powers of draught, and, in default of them, has to draw from the lateral purchase of his limbs instead of from his height, and thereby unduly to tire his muscles and joints and strain them; and, if he stumbles, the danger of his falling is increased. The instinct of a horse in stumbling is to let his head drop to a certain point where it helps to restore equilibrium. A rein adjusted to catch the head at that point would be helpful, but the common tight reins prevent its dropping at all, and thereby augment the insecurity of the horse.

Cultivation of the Date-Palm.—Dates are cultivated profitably in two oases of the Algerian Sahara. At the oasis of Rir, where the conditions are most favorable, an unfailing supply of water is obtained by artesian wells from a depth of about two hundred feet. The use of these wells has been known to the natives from time immemorial, but has been facilitated, and the number of them has consequently increased since the introduction of improved systems of boring by the French. Sixty-four of the wells had been bored by the French in 1878, furnishing an average of more than 1,500 quarts of water each a minute. They vary among themselves greatly in capacity, one of them

being rated at 4,800 and another at 20 quarts a minute. At the averaged rate of supply, each of the wells should furnish water enough to sustain 15,000 palm-trees, representing a plantation of 425 acres. Each tree, if thriving, well manured, and cared for, will bear from one hundred to one hundred and twenty-five pounds of dates; raised by the quantity and without manure or particular attention, the average crop per tree is thirty-five or forty pounds, and this is worth about sixty cents. It is not a matter of very great expense to start a plantation of dates. A lot of five or six hundred acres, on which 30,000 trees may be planted, can be bought for about five hundred dollars; the wells will cost eight hundred dollars apiece; the trees cost about thirty cents apiece; and M. Jus estimates the whole expense of stocking an oasis with 10,000 trees at about $4,000. The trees are expected to bear a crop in the fifth year after planting. The cost might be greater and the time of waiting longer than is calculated, as will often probably turn out to be the case, and the enterprise still be a profitable one, especially as the expense of the outlay, it is thought, may be nearly covered by the barley that may be raised with the aid of the winter rains. The care of the young trees is intrusted to tenant farmers, who take half the barley and a sixth of the dates. When the plantation has come into bearing, it will return, if all is prosperous, 375,000 pounds of dates, worth $6,000 gross, of which the proprietor receives $4,800, or a few hundred dollars more than his estimated first outlay. The prospect has proved flattering enough to attract the attention of a few capitalists who have started several plantations near Ourlana, in the center of the oasis.

The Poisonous Principle of Bulbs.—Professor Husemann remarked several years ago that a certain class of poisons was generally diffused in plants of the families *Liliaceæ* and *Amaryllideæ*. His view has been confirmed by the results of later researches. Gerrard has extracted from the tulip a poison called *tulipin*, the nitrate of which, according to Sydney Ringer, has the power of stopping the contraction of the heart, with many of the properties of veratrin. Professor Warden, of Calcutta, has extracted from a lily of India a very poisonous principle (superbin), which appears to be identical with the scillitoxin of the squill, and a very small dose of which killed a grown cat. The presence of the poisonous principle in bulbs, on which many plants are more dependent for propagation than on the seed, has an important bearing on the perpetuity of species by its agency in preserving them from the attacks of animals which would be likely to destroy them by eating them. While the poisons are comparatively harmless to men, they are peculiarly deadly to the *rodentia;* and it is from the depredations of animals of this class that bulbs would be most likely to suffer.

Scope and Value of Anthropological Studies.—Professor Otis A. Mason, in his address before the Anthropological Section of the American Association, on the "Scope and Value of Anthropological Studies," answers the inquiry as to what benefit the world has derived from the cultivation of that science: First, every study is improved by study, and, if "the proper study of mankind is man," it is eminently important that that should be improved and pursued scientifically. Secondly, the value of a study must be estimated by its effects upon human weal; and are not the questions agitated by anthropologists connected with human welfare? "Do they not relate to the body, mind, and speech of man, to the races of mankind, their arts, amusements, social needs, political organizations, religion, and dispersion over the earth? For instance, the French in Africa, the British in India, and our own citizens in malarious and fever-laden regions, have they not learned from loss of treasure, ruined health, and the shadow of death, that there is a law of nature which can not be transgressed with impunity? It is the same with sociology and religion. The pages of history glow with the narratives of crusades against alleged wrongs, which were in reality campaigns against the sacred laws of nature. Social systems, which had required centuries to crystallize, have been shattered in some effort to bend them to some new order of things. Arts and industries planted in uncongenial soil, at great

expense, have brought ruin upon their patrons, who had not studied the intricate laws of development. . . . The better knowledge of races and race peculiarities has revolutionized and humanized the theories of aborigines. The doctrine of extermination, formerly thought to be the only legitimate result of colonization, has become as odious as it is illogical. The inductive study of mind has hardly begun; but how much more successfully and rapidly will education and the development of the species progress when the teacher and the legislator can proceed at once from diagnosis to safe prescription, when natural selection and human legislation shall coöperate in the more speedy survival of the fittest"! A third benefit of the study is the opportunity which the science affords for the exercise of every talent, even the highest. It is possible for every craft to prosecute its researches and make its contributions on the subject.

The Big Trees of Turkistan.—According to ancient accounts, the mountains of Turkistan were formerly covered with large and handsome forests. Now, the absence of trees and the savage nudity of the mountain-slopes are what most strike the traveler in that country. The denudation would, perhaps, have been complete by this time if the Russian Government had not interposed to prevent further waste; and the restoration of the forests is at present under consideration by a commission. The growth of plants in as hot a climate as that of Turkistan is very rapid. Trees at Samarcand and Tashkend have been known to make growths by measure in a single year of from fifteen to nearly twenty feet, and a corresponding development in thickness. Nevertheless, fine trees are very rare, though a few exist of extraordinary size. They are generally found near some holy place or overshadowing some mosque or hermit's retreat, where they owe their preservation to the respect in which the natives hold the shrines to which they appertain. The Sartes of Tashkend tell of an arbor-vitæ, in the inclosure of one of the mosques of their town, which is nearly six feet and a half in diameter and five thousand years old. A French traveler has measured mulberry-trees at Ourgout and at Salavad that were more than sixteen feet in circumference at the height of the shoulder, but they did not seem to grow proportionately in height. These trees were all in religious places, and were accompanied by plane-trees of equal size. The latter tree is occasionally found of really wonderful dimensions. Madame O. Fedtchenko made a drawing of one which was six feet four inches in diameter, the interior of which had been converted into a little *medresseh*. It was growing on a saint's tomb, not far from Samarcand. A plane-tree in the Tajik village of Saïrôb is twenty-seven feet and a half in circumference at the height of the shoulder. It has been protected from the wash of rains by a barrier of stones, and its hollow trunk has been formed into a square room and fitted up as the village school-house. Near it is another twenty-six paces in circumference at the base. The people say that these trees were planted by Ali. Of a group of old plane-trees at Chojakend, east of Tashkend, the largest is a rotten and hollow old stump, looking like the ruin of a giant wall, from which six vigorous lateral trees have shot up. The whole plant is forty-eight paces in circumference at the base, and the hollow of the principal trunk is nine metres, or more than twenty-seven feet, in diameter. A party of a dozen tourists from Tashkend once had a feast in the inside of this stump, and were not cramped for room.—*La Nature.*

Anthropology and Philanthropy.—Professor Otis T. Mason, in his American Association address on the "Scope and Value of Anthropological Studies," speaking of their value to philanthropy, says: "With what admiration do we read of the devotion of those missionaries who have suffered the loss of all things in their propagandist zeal! Science has her missionaries as well as religion, and the scientific study of peoples has notably modified the methods of the Christian missionary. The conviction that savage races are in possession of our family records, that they are our elder kindred, wrinkled and weather-beaten, mayhap, but yet worthy of our highest respect, has revolutionized men's thoughts and feelings respecting them. The Bureau of Ethnology has its missionaries among many of the tribes in our domain, no longer bent on their destruc-

tion, but treating them with the greatest consideration, in order to win their confidence, to get down to their level, to think their thoughts, to charm from them the sibylline secrets. It sounds something like the old Jesuit relations to hear of Mr. Cushing at Zuñi eating vile food, wearing savage costume, worshiping Nature-gods, subjecting himself to long fastings and vigils, committing to memory dreary rituals, standing between disarmed Indians and their white enemies on every hand, in order to save their contributions to the early history of mankind. You will recall the fact that an honorable senator more than a year ago offered, as an argument against sudden disruption of tribal affinities, an elaborate scheme of the Wyandotte Confederacy."

Farming in Japan.—According to the report of Consul Van Buren, the Japanese farmer holds in public opinion and estimation an exalted position. He is owner of the soil he tills, is generally represented by members of his class as officers in the agricultural villages, and has electoral rights which are in some instances exclusive. His position has been raised, and his privileges have been increased, during the last two years. A considerable percentage of the land-owners are able to employ laborers, and are thus not themselves tied to labor; but the farm-work allows no rest, for in the mild climate the hardier crops may be raised in the winter as well as others in the summer. Almost every farmer can read, write, and keep his farm accounts. He sends his sons to school, and his daughters are taught needlework and music at home. The labor on the farm is all mere hand-work; a plow is seldom seen, but a kind of long-toothed harrow is sometimes used to follow the mattock. The laborers are treated with great kindness. Those engaged in the cultivation of tea, silk, and sugar, need more skill than the others, and are paid higher wages. They live almost entirely on vegetable food, refraining from the use of meat by virtue of religion, custom, popular prejudice, and necessity. Their clothing is extremely light, and does not cost more than about four dollars a year. Several holidays are allowed each year for religious festivals and family celebrations, and the laborers generally have small gardens attached to their cottages. Women and children are employed in tea-picking, and in the lighter and in-door operations of silk-culture, and are paid for skill. The labor employed on the cotton plantations is not skilled, and is paid for at low rates. A farming population of 15,500,000 is engaged on 12,000,000 acres of land, giving about three quarters of an acre to each person. The tillage is of the most thorough order. Two crops are raised each year, so that the producing capacity of the land is double what it appears to be.

Animal Plagues.—Mr. George Fleming, in his recent work on "Animal Plagues," remarks that no description of disease, sufficiently exact to be identified with the type of which pleuro-pneumonia is an example, is found till about two hundred years ago. Even then, the earliest record suggesting that disease is of a doubtful character. It dates from 1613, when there had been a course of years marked by phenomenal disturbances, mildew, and blight. Oxen and cows died in great numbers from a pulmonary phthisis that appears to have been brought on in part by severe cold after intense heat. Men also were attacked with dysentery and malignant fevers. In 1713, again, a "cattle-plague," distinctly so described, raged over Europe, and wild creatures suffered with the tame. In 1725 a wet and chilly year of blight was followed by an exceedingly dry and hot one; honey-dew and rust were abundant on the crops and foliage; a great mortality prevailed among cattle; while the deer perished in numbers, and even the fish suffered. In 1769, after a rainy year and a bad harvest, a lung-disease, called *murie* in Franche-Comté, raged among the cattle and horses in the north of France; but it appears to have been less virulent than genuine bovine contagious pleuro-pneumonia. About 1779 the last-named disease, now thoroughly ascertained and distinguished from other cattle-plagues, appeared in Upper Silesia and Istria; then, after holding its ground there for many years, it spread to Bavaria. It was carried into France during the wars of the French Revolution, into Italy in 1815, and into Holland and Belgium in 1827. Having established itself upon the Continent, it was introduced into England in 1841, when

Liverpool and other ports at which diseased animals were landed became centers of contagion. The history of this disease is only one example out of many in the list of maladies to which animals are liable. The study of Mr. Fleming's histories induces the conviction that hardly a creature in any way connected with man, or coming under our observation, is free from liability to hosts of plagues, or has not its full share of special or common troubles. Mr. Fleming's work is published in England.

Wind-Sounds in the Desert.—The travelers' tales of sounds like the ringing of bells, which they have heard in deserts and lonely places, are familiar. Some of them are too well substantiated to admit of serious dispute. Among them is that of the noises heard at the Gebel Nakus, in the Sinaitic Peninsula, which the Arabs say proceed from a convent of damned monks; the musical cliffs of the Orinoco, told of by Humboldt; and the sounds which the French *savants* Jollois and Devilliérs declare they heard at sunrise at Karnak, Egypt, and described as comparable to the ancient fable of the vocal Memnon. The sounds are not always or exactly like the ringing of a bell; sometimes they resemble the music of a string, and may be generally described as of an intermediate character between the two classes. A characteristic of the sounds is, that no one can discern where they come from. M. Émile Sorel, *fils*, in order to determine their origin, has made some successful experiments in reproducing them artificially. Taking his gun into an open field, he placed it at an angle of 45° against the wind, when it gave forth a sound. Then moving it around, he caused it to utter the exact tone he sought. The sound could not be localized. Addressing a peasant, he asked him, "Do you hear my gun?" "Pardon, monsieur, it is the bells of ——." A similar answer was got from every one whose attention was called to the noise. It was believed to come from about two miles and a half to the windward. M. Sorel believes this experiment authorizes the hypothesis that the ringing is the result of the blowing of the wind over a slope at the foot of which is something that may act as a resonator. What is done on a small scale in a gun may be done on a large scale in nature, on the face of a mountain or a rock which is backed by a valley or a ravine, or which is itself elastic enough to give the resonant effect. The sounds are apparently not as readily given when the vibrating surfaces and media are moist.

Artificial Drying of Fodders.—A practical, economical apparatus for artificially drying fodder-crops might be the means of effecting immense savings to farmers in bad seasons for hay-making. Mr. William A. Gibbs has described before the British Society of Arts two such apparatuses which, he claims, accomplish the object at a cost that makes their use profitable. His own apparatus, which he has spent many years in perfecting, is in its primitive and simplest form a stove or furnace for burning coke, to which is attached a fan for blowing the hot air resulting from the combustion—of a temperature that may rise to 520°—through the wet grass. An exposure of from four to six minutes is sufficient to convert each lot of grass—the proportion of which is adapted to the force of the blast—into hay. This has been developed into a machine of eleven tons weight "which, when in action, eats up a one-horse load of coke, draws off ten to fifteen tons of water, and converts twenty great cart-loads of wet rubbish into good stack-hay in a single day's work." The perfected machine has a system of giant forks and flat iron plates, kept in rapid action, through which the wet grass is shaken down in successive stages while it is permeated through and through with the hot air. Another process, the invention of Mr. Neilson, is for cooling hay in the stack, and uses the heat which is developed in the natural process of "heating," to dry the whole. A hole six inches in diameter is bored through the stack to the point at which the greatest heat is developed, and a fan fixed at the outlet of the hole is made to draw off the heat from that point and promote the ventilation and drying of the whole mass. Mr. Gibbs believes that these processes are about equal in value, and that their value is real. He also described a "sheaf-tube" for drying sheaves of wheat. It is "like a gun-barrel open at both ends, and about eighteen inches long; such tubes

as these are stuck into sockets all over a plate-iron floor, at just such a distance apart as will enable a wheat-sheaf to be comfortably spiked upon each tube. The floor, with its small forest of tubes, is laid, air-tight, upon a dwarf foundation wall of about two bricks high, with a partition down its center. The hot-blast is then blown into the closed space thus formed between the ground and the tube floor, and rises through the tubes into the sheaves just where they are wettest, viz., at the band. A simple shunting valve directs the hot air first under one half of the floor, and then under the other, so that, while the sheaves on one half are drying, the others may be lifted off and replaced with more wet sheaves."

Fogginess of Malaysian Ideas.—Mr. D. D. Daly, who has been engaged in surveys of the native states of the Malay Peninsula, says that the natives show an almost total lack of notions of definite points, and have only the vaguest ideas with reference to the determination of boundaries. "The boundary of our state," said one, "extends as far as the meeting of the fresh water with the salt water of the river"; or, "If you wash your head before starting, it will not be dry before you reach the place"; or, "The boundary may be determined on the river, as far as the sound of a gun may be heard from this hill." The shot might be fired from a smooth-bore or from a twelve-pounder, or a gale of wind might carry the report farther than was contemplated. Such ambiguous phrases were calculated to mislead, but they were essentially Malaysian in their generality.

Electricity from Gas.—A German professor, Dr. Von Marx, has shown that more light can be obtained from a given quantity of gas by burning it in a gas-motor which drives a dynamo-machine, than by burning it in the ordinary burner. His estimate is based on the following calculations: A gas-motor will consume on the average thirty-seven cubic feet of gas per hour for each horse-power. An argand burner, giving a light equal to eighteen candles, will consume five and a half cubic feet per hour, so that the amount of light obtained by burning thirty-seven cubic feet of gas in an argand burner will equal one hundred and twenty candles. In the Swan system of electric lighting, the light obtained from each horse-power (or by burning thirty-seven cubic feet of gas) is stated to be equal to one hundred and fifty candles. The light obtained by the Edison lamp he gives as between one and two hundred candles. Mr. Lungren, in his paper in the September number of "The Popular Science Monthly," estimates that eight lamps can be maintained for each actual horse-power, and if we make each lamp equal eighteen candles, we have a total of one hundred and forty-four candles per horse-power, a gain of twenty per cent over the use of an argand burner. When the Jablochkoff candle is used, the results are much higher, each horse-power yielding a light equivalent to four hundred and seventy-two candles; while other arc systems run four or five times as high. In showing that more light is obtained by burning thirty-seven feet of gas in a gas-motor than by burning it in an argand burner, Professor Von Marx does not prove that it would be economical to do so, for the margin, taken as twenty per cent, is not sufficient to cover the cost of converting gas into electricity, so to speak. That the latent energy pent up in illuminating gas should produce more light when converted into electricity, notwithstanding the loss at each stage of the operation, than when burned directly, is explained by the fact that the larger part of the energy of burning gas is manifest in the form of heat, the lesser part in the form of light. In electricity we have just the opposite conditions.

Transparent Points in Leaves.—M. Theodore Bokorny has published a prize essay in the University of Munich on the "Transparent Points in Leaves." These points, which are quite common in some plants, mark the places where a group of cells, containing resin or an ethereal oil, has been collected. One of the most familiar instances of this kind is that of the St.-John's-wort (*Hyperieum perforatum*), in which mediæval superstition imagined a connection between the lucid spots and the wounds of Christ, and assigned a healing virtue to the plant. In other cases the points in question are caused by cells with a slimy coat-

ing which produce secretions of slime, or by the presence of cells containing crystals of oxalate of lime. The operation of these agencies is associated with the action of secretory organs, or glandular processes, causing a tendency of particular substances to certain points. The cells forming the transparent points probably have some particular significance in connection with the life of the leaf, for their occurrence is so uniform in particular species that they become distinguishing marks by which the species is known. So, also, the presence of raphides-cells (cells containing needle-shaped crystals of oxalate of lime) is constant in some families, as in the *Dioscoreas*, *smilaxes*, and *Taccaceæ*, although the transparent points are rarely observed in their leaves. Cells containing resin or ethereal oil are constant in at least three species of pepper, and in all of the *Monimiaceæ*. Interior glands, with brown radiating crystals of resinous substance, are characteristic of the *Myrsiniceæ*, and are wanting in only a few species. The anatomical structure which leads to the production of these points evidently has some systematic importance, and should not be overlooked in the determination of the characteristics of the different groups.

NOTES.

In Dr. Pyburn's article on "A Home-made Telescope," in the last (November) number of the "Monthly," page 86, seven lines from the bottom, the diameter of the thirty-inch roller is given as "two and five eighths inches"; it should read "one and five eighths inch."

Professor Baird announces the final solution of the problem of the culture of oysters from artificially impregnated eggs. The Government station at Stockton, Maryland, had in September last many millions of young oysters three quarters of an inch in diameter, which had been hatched from eggs artificially impregnated forty-six days before. Oysters had already been artificially impregnated by Dr. Brooks, but the practical difficulty existed of preventing the young oysters, which could pass through the meshes of the most closely woven fabrics, from escaping.

Our Educational Bureau is circulating an excellent paper from an address given to school-teachers in Switzerland on how natural science should be taught. The object, it says, should be, not to fill the mind with facts, but to bring all the scholars, including the slowest ones, to discover and observe facts for themselves. Books should be little used, and nothing about an object should be taught without the object being before the class. The next lessons should be in describing the facts observed, with the help of drawing, if possible. Plants should be chosen first, then animals of different classes, then minerals, with observations of mechanical and afterward of chemical effects upon them. But the bare making of collections should not be particularly encouraged.

The "United States Hay Fever Association" held its tenth annual meeting at Bethlehem, New Hampshire, during the last week in August. The speeches made and the experiences related indicate that the cause and specific cure for the uncomfortable disease in question are yet to be found. A particular preparation which has been much recommended was, by nearly general consent, pronounced of no value as a remedy. Much information regarding the malady had been gathered by Dr. Geddings.

The lowering of the freezing-point of water by increased pressure is frequently illustrated by the experiment of Bottomley, which consists in throwing across a cake of ice a wire weighted heavily at both ends. The wire slowly sinks through the cake, the ice melting beneath it and freezing above it. Professor Guthrie, at a meeting of the Physical Society in London, has stated his belief that the wire conducts heat to the ice from the atmosphere, and that therefore the experiment does not illustrate the fact above mentioned. A silk cord weighted to the same amount as a wire will not cut through a block of ice.

The death is recorded of Hermann Müller, of Lippstadt, one of the most industrious and distinguished scientific investigators of the day. His specialty was the fertilization of flowers by insects, in which subject he was regarded by naturalists as the highest authority. He was the author of two books on the subject, "Die Befruchtung der Blumen durch Insecten" ("The Fertilization of Flowers by Insects"), recently translated into English, and "Alpenblumen, ihre Befruchtung durch Insecten" ("Alpine Flowers, their Fertilization by Insects"); of an article in Schenk's "Handbuch der Botanie," and of frequent contributions to the German periodical "Kosmos."

Ernest Ingersoll observes, in the "American Naturalist," that if we judge by the standard of their possessing a convenient currency, the American Indians must be ranked high among barbarians in point of advance toward civilization. They had in their wampum a regular money of recognized value. It marked an advance upon

the African cowry, for, while the latter was simply a shell with a hole in it, wampum was a manufactured article, made with a degree of patient labor which was included in estimating the value given to it. That to which the most value was attached was made from the dark part of clam-shells. An inferior "coinage" was made from the white parts of the shells, and from periwinkle-shells. The value of wampum was almost as well defined as that of our own money, and regular tests were in use for judging of it. Shell-money was also used by the Indians of the Pacific slope; and Mr. Ingersoll describes three kinds of it, all somewhat different from genuine wampum.

MR. ERNEST HART, Chairman of the London Smoke Abatement Institute, remarks that at the recent exhibition by that society improvements in the construction of open fire-places were shown by which common bituminous coal can be consumed in a practically smokeless manner. Simple methods of underfeeding were exhibited which proved to be productive of admirable results both in respect to economy of fuel and reduction of smoke from ordinary coal. Mr. Hart recommends as an elementary measure of economy the use of equal quantities of coke and coal mixed. He has great expectations of the realization of Dr. Siemens's projects for using gas as a heating agent.

THE French Academy of Sciences has had a discussion about busts. It was invited to witness the progress of the bust of Leverrier, and express an opinion as to the quality of the resemblance and the work. M. Bertrand took the opportunity to speak of the scandalous badness of some of the busts in the hall of the Academy, particularly of those of Delaunay and Claude Bernard, which, he said, were mere caricatures, and to advise that they be turned out at once; and M. Dumas remarked that several of the busts were in reality only fit to be used for making carbonic acid.

MR. CROMWELL FLEETWOOD VARLEY, F. R. S., an English engineer distinguished for his work in connection with electric telegraphs, died September 2d. He devised a method of locating distant faults in land telegraphic wires, and was associated with other engineers in devising the first really successful Atlantic cable.

THE curious question has been raised in England whether the recent decline in the death-rate has actually added to the average length of useful life, or whether its benefits have not chiefly been spent in relatively unimportant prolongations of the lives of children and of the aged. It has been answered by Mr. Noel A. Humphreys, after a new examination of the returns of mortality, and the compilation of new life-tables. He finds that the average expectation of life of males at birth has been raised from 39·91 years, as it was fixed in Dr. Farr's tables, to 41·92 years by the new tables, or has been increased by two years, or five per cent; and that the expectation of females has been raised from 40·86 years to 43·56 years, or by 2·70 years, or nearly 7 per cent.

CHARLES F. PARKES, Curator of the Academy of Natural Sciences of Philadelphia, died September 7th, after a long illness. He had considerable distinction as one of the leading botanists of America, and had paid special attention to the botany of New Jersey.

PROFESSOR C. V. RILEY, in a paper read at the American Association recommends emulsions of petroleum to be applied to plants as insecticides. A soap emulsion of twenty parts of scraped bar-soap, ten parts of water, thirty parts of kerosene, and one part of fir-balsam, is stable enough for all practical purposes, but milk emulsions are better. One or two parts of refined kerosene to one part of sour milk is quite satisfactory. It must be churned till a butter is formed, which is thoroughly stable, and will keep indefinitely in closed vessels, and may be diluted at pleasure with water when needed for use. An emulsion of gum from the root of *Zamia integrifolia*, of Florida, has proved useful. The diluted emulsion, of strength varying according to the plants and insects to which it is applied, should be finely sprayed upon the insects to be killed.

SCIENCE has furnished another victim to African sickness in the person of Mr. William Alexander Forbes, Prosector to the Zoölogical Society of London, whose death on the Niger River has been reported. He made an excursion to the forests of Pernambuco, Brazil, in 1880, afterward passed some time in the United States, and started from England for Africa and the eastern tropics, in July, 1882. His published works consist chiefly of about sixty papers in the "Proceedings of the Zoölogical Society" and the "Ibis."

M. ENGELMAN has been studying the manner in which the movements of the lower organisms are influenced by light. He finds that light may act in three ways: 1. Directly, by a modification of the exchanges of gases; 2. By modifications of the sensation of respiratory necessities, and, 3. By means of a specific special process corresponding probably in some sort to our luminous perception.

MR. THOMAS PLANT, a life long student of meteorology, died in Birmingham, England, about the 1st of September. His regular records of the weather and associated phenomena are complete for forty-six years.

ÉTIENNE GEOFFROY SAINT-HILAIRE.